# 3 AFFECTED ENVIRONMENT

## 3.1 Introduction and Physical Setting

### 3.1.1 Introduction

Chapter 3, "Affected Environment" describes the existing environment that would be affected by the proposed Project and alternatives under consideration in this EIS. Chapter 3 provides the basis for the impact assessment documented in Chapter 4, "Environmental Consequences." This chapter begins with an overview of the physical setting of the proposed Project, followed by detailed discussions of the affected environment for each resource area listed below:

- Geology and Soils (Section 3.2)
- Groundwater Hydrology and Water Quality (Section 3.3)
- Surface Water Hydrology and Water Quality (Section 3.4)
- Water Supply and Floodplains (Section 3.5)
- Wetlands and Other Waters of the United States (Section 3.6)
- Aquatic Resources (Section 3.7)
- Terrestrial Resources (Section 3.8)
- Federally Listed Species (Section 3.9)
- Socioeconomics and Environmental Justice (Section 3.10)
- Land Use (Section 3.11)
- Transportation (Section 3.12)
- Cultural Resources (Section 3.13)
- Visual and Aesthetic Resources (Section 3.14)
- Recreation Resources (Section 3.15)
- Air Quality (Section 3.16)
- Noise and Vibration (Section 3.17)
- Health and Safety (Section 3.18)
- Hazardous Materials and Waste (Section 3.19)

The discussion of each resource includes the types of potential impacts typically associated with mining; the defined study area; the applicable regulations; and the overall existing condition of the resource, including the natural and physical environment. For each resource analyzed in the EIS, the study area is consistent with the Project area unless otherwise specified. For some resources (e.g., socioeconomics), the study area is larger than the Project area because potential effects extend beyond the Project boundary.

### 3.1.2 Physical Setting

#### 3.1.2.1 Location

Haile Gold Mine is located 3 miles northeast of the Town of Kershaw in southern Lancaster County (Figure 1-1), within the geographic area known as the Carolina Slate Belt in northern South Carolina (Figure 1-2). The Project boundary as defined in the revised DA permit application submitted in August 2012 (Haile 2012) encompasses 4,596 acres. Several parcels of land within this acreage are not owned by Haile, and no mining activity would occur on these parcels. The acreage of the Project area (4,552 acres) does not include this land.

### 3.1.2.2 Climate

The climate in the Project area is heavily influenced by the proximity of the Atlantic Ocean and the Appalachian Mountains (Tetra Tech 2012). The climate is described as subtropical, typically experiencing hot, humid summers and mild, wet winters. July is the warmest month, with an average daily maximum temperature of approximately 90 ºF and an average daily minimum temperature in the upper 60 ºF range. The coolest month is January, with average daily maximum temperatures in the mid 50 ºF range and average daily minimum temperatures in the upper 20 ºF range (weather.com 2013).

Precipitation is abundant throughout the year. The annual precipitation in the Project area is approximately 46 inches per year, and annual snowfall is typically less than 6 inches per year (Schlumberger Water Services 2011). In general, South Carolina averages 50 days of thunderstorm activity and 15 tornadoes annually (SCSCO 2013). The Project area is just outside of the hurricane susceptibility region designated by the Federal Emergency Management Agency (FEMA). Estimated wind speeds at the Project area could reach a maximum of approximately 200 miles per hour (mph) during an extreme wind event (tornado or hurricane) (FEMA 2010).

Climate trends over the period of record (1895–2006) for South Carolina indicate that the average annual temperature has decreased approximately 0.5 °F, and average annual precipitation has increased approximately 3 inches (SCSCO 2008).

### 3.1.2.3 Topography

Figure 1-2 shows the location of Haile Gold Mine in relation to the Carolina Slate Belt and includes the surrounding physiographic provinces. *Physiographic provinces* are regions with similar physical features, such as terrain, rock type, and geologic structure. Based on physical and ecological conditions, the Project area falls within the Piedmont physiographic province of the southeastern United States.

The southeastern Piedmont physiographic province is characterized by gentle topography and rolling hills, dense networks of stream drainages, and red-brown saprolite (chemically weathered rock) soils. Slopes within stream drainages are gentle to moderate (approximately 9–13 percent); upland slopes above the stream drainages are gentle to nearly flat (up to 1 percent). The elevation in the Project area ranges from 350 to 550 feet above mean sea level (msl). The topography in the Project area has been altered by past mining operations.

The Project area is dissected by the perennial (continuously flowing) Haile Gold Mine Creek and by its intermittent (seasonal) tributaries. A more detailed summary of surface waters in the Project area is provided in Section 3.4, “Surface Water Hydrology and Water Quality.”

### 3.1.2.4 Groundwater

Groundwater in the Project area is a function of the climate, geologic conditions, and surface topography. The depth to groundwater tends to follow topography across the site—shallower in topographically low areas and deeper in topographically high areas. A southwest groundwater flow direction follows the Haile Gold Mine Creek drainage (Schlumberger Water Services 2010; AMEC 2012).

Groundwater can be thought of as three inter-connected aquifers present at various depths and within different geologic strata—the Coastal Plain Sands (CPS) aquifer, saprolite zone aquifer, and bedrock aquifer. The shallowest aquifer is the CPS aquifer; it consists of water that has infiltrated from rainfall into the CPS, a layer of sand variably ranging from 0 to 75 feet and generally thinning toward the western portion of the Project area. Where the CPS aquifer is present, groundwater is generally less than 30 feet below ground surface. The saprolite zone aquifer consists of water present in the saprolite layer, which is comprised of clay cut by numerous quartz-rich dikes. This aquifer can be up to 175 feet thick in the Project area. The deepest aquifer is the bedrock aquifer, consisting of water within variably fractured, metamorphized sedimentary and volcanic rocks. The water in this aquifer flows through fractures within the rocks themselves and is highly variable across the Project area. The majority of public and private wells are present within the bedrock aquifer. Groundwater occurrence and flow in the bedrock aquifer system varies greatly, depending on the number of joints and fractures intersected by individual wells and on the extent of the fracture system.

Groundwater generally flows from recharge in the upland areas of a watershed (rainfall entering headwater streams) to discharge areas that are typically surface waterbodies. Recharge is believed to occur over much of the Project area, with discharge occurring to Haile Gold Mine Creek and other surrounding creeks. In general, there is a high degree of connection between shallow groundwater and surface water. A more detailed summary of groundwater in the Project area is provided in Section 3.3, “Groundwater Hydrology and Water Quality.”

### 3.1.2.5 Surface Waters

The Project area is located in the headwater portion (origin) of the Lynches River watershed. A *watershed* is a region that drains to the same river or other body of water. The Lynches River watershed originates in the southern Piedmont area and drains southeasterly through the Carolina Sandhills, Southern Coastal Plains, and Atlantic Coastal Flatwoods ecoregions. An *ecoregion* is a distinctive community of similar plant and animal species due to similar climate, hydrology, and geologic features. The Lynches River eventually discharges to the Pee Dee River, which empties into the Atlantic Ocean approximately 230 river miles from the Project area, near Georgetown, South Carolina. (NRCS 2010). Section 3.4, “Surface Water Hydrology and Water Quality” provides further detail on surface waters in the Project area.

### 3.1.2.6 Land Cover

Land cover in the Project area is predominantly forested land, open undeveloped areas of grass/scrub-shrub, agricultural land, and developed land. Other land uses in the vicinity of the mine include residential, agricultural, and wetlands. Wetlands in the Project area have been mapped according to the Cowardin classification system and are classified as palustrine (forested wetland) and riverine (associated with waters of the United States) (Cowardin et al. 1979). Detailed descriptions of the types and extent of wetlands in the Project area are found in Section 3.6, “Wetlands and Other Waters of the United States.”

Mining activity in the Project area has been occurring since 1827. While gold mining in the previously mined area was suspended in 1992, mining for other minerals and sand continued until 2010. Portions of the Project area also have been heavily logged. Post-closure reclamation monitoring programs and maintenance activities are currently in progress in the Project area, as required by previous mining permits. Past mining and reclamation activities in the Project area have disturbed approximately 252 acres, as shown in Figure 1-3.

On April 8, 2013, the Haile property within the Permit boundary was rezoned to the M, Mining District designation (Ordinance 2013-1207). The allowable use under the M, Mining District is mining and related activities that involve the extraction and processing of mineral materials, including exploration, processing, operation and reclamation-related activities (Lancaster County 2013).

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# 3.2 Geology and Soils

The proposed Project may directly and indirectly affect geology and soils, and may be affected by the geology of the area. The study area for geology and soils is the area within the Project boundary.

Potential effects on geology and soils from the proposed Project include loss of soils and surface materials as a result of excavation and of construction of facilities, including roads, the TSF, and OSAs. Soils and surface materials would be eroded due to Project activities and associated changes to slopes and drainage patterns at the site. Long-term changes in soil type and cover across the Project area resulting from changes in the landscape also could occur. The potential direct and indirect impacts on geology and soils are addressed in Section 4.2.

Waste rock and ore would be recovered from the proposed open pits, which would result in surface exposure of PAG pit walls. This section describes the identified categories of waste rock and ore present in the Project area. The potential indirect effect of contamination to sediments and their effects on groundwater, surface water, and wetlands and Waters of the U.S. are discussed in Sections 4.3, "Groundwater Hydrology and Water Quality"; 4.4, "Surface Water Hydrology and Water Quality"; and 4.6, "Wetlands and Other Waters of the United States," respectively.

Naturally occurring seismic (earthquake) events have the potential to produce unstable conditions that could directly affect the proposed facilities. This effect is addressed in Section 4.2.

Other issues that were considered but are not addressed further in the EIS include the potential loss of paleontological resources and subsidence. Paleontological resources are not known or suspected in the Project area (Gohn et al. 1992). Natural subsidence is unlikely to occur in the Project area because of the thin and limited CPS units located onsite, and because the mining method does not have the potential for subsidence.

## 3.2.1 Regulatory Setting

The following federal and state regulations apply to the geology and soils in the Project area. These regulations apply principally to runoff-induced erosion and effects on water quality. See Appendix F for further details on regulations that apply to the proposed Project.

- **National Pollutant Discharge Elimination System General Permit Number SCR100000, effective September 1, 2006 –** The NPDES permit allows for the discharge of pollutants to surface waters of the state in accordance with the conditions and requirements outlined in the permit.
- **South Carolina Code of Regulations 63-380, *Standard Plan for Erosion, Sediment, and Stormwater Runoff Control*** – This plan requires that construction designs be submitted to the South Carolina Department of Transportation (SCDOT) Resident Maintenance Engineer for approval. Designs must include stormwater management and temporary and permanent erosion and sediment control features to minimize soil erosion and runoff.
- **Erosion and Sediment Reduction Act of 1983 (Title 48, Chapter 18 of the South Carolina Code of Laws of 1983, as amended)** – Section 70 of this code authorizes the SCDHEC to administer regulations for erosion and sediment reduction and stormwater management on land and land-disturbing activities, in consultation with the SCDOT.
- **South Carolina Mining Act, Title 48, Chapter 20 –** The SCMA requires that topsoil and overburden be stored in a way to prevent its removal or transport out of permitted areas and to be used for future reclamation activities. It also specifies certain requirements for reclamation design and implementation.

- **South Carolina Interstate Mining Compact, Title 48. Chapter 21 –** The South Carolina Interstate Mining Compact requires prevention of soil pollution from mining operations past, present, and future.

### 3.2.2 Existing Conditions

This section describes the geology, soils, and characteristics of the rock and ore to be excavated, and the seismicity for the study area.

#### 3.2.2.1 Site Geology

*Stratigraphy* refers to the study of rock formations, in particular their composition, distribution, and age. The generalized stratigraphy for the Project area includes the following principal geologic layers and lithologic units (the physical characteristics of the rock units): bedrock, dikes, saprolite, and CPS. These features are described in the following text. Figure 3.2-1 presents a generalized stratigraphic section.

##### Bedrock

*Bedrock* is the consolidated rock that underlies the loose surface soil. The bedrock stratigraphy of the Project area consists of the Richtex and Persimmon Fork Formations from the early Cambrian to Pre-Cambrian age. The Richtex Formation is considered to be the primary host rock for mineralization in the Project area (Haile 2011). This is known as a metasedimentary bedrock unit and is characterized by thin, alternating rhythmic bands of silt, clay, and sand that have been metamorphosed by elevated heat and pressure over geologic time.

##### Dikes

A *dike* in geology is a sheet of rock that cuts vertically across existing strata, as shown in Figure 3.2-1. Numerous dikes thrust (“intrude”) into the Richtex and Persimmon Fork Formation bedrock units. The typical thickness of the dikes varies from 15 to 100 feet, although some of these dikes occur as numerous closely spaced thin dikes (Haile 2011). Dikes are notable features, as they can represent barriers that limit groundwater flow across them.

##### Saprolite/Sap-Rock

*Saprolite* refers to weathered bedrock, often rich in clay, that occurs as a thin layer overlying the majority of the bedrock in the Project area. The saprolite layer in this area is generally dense and varies in color from white to red-brown. The thickness of the saprolite unit varies from 5 to 150 feet, with an average thickness of 55 feet. Saprolite is typically thicker in areas where the Persimmon Fork Formation is closer to the surface and thinnest where the Richtex Formation is the metamorphic rock unit closer to the surface.

The contact zone between the saprolite and bedrock is poorly defined and, in some cases, weathered material may underlie apparently unweathered bedrock. In some areas, the saprolite transitions into sap-rock, which is sturdier and retains the parent rock’s original structure. The sap-rock has experienced weathering or alteration and is suspected to be the primary zone of groundwater flow across the Project area. Groundwater flows more slowly through sap-rock than through saprolite, due to the limited weathering in the sap-rock and smaller flow paths in the rock.

### Coastal Plains Sand

Coastal Plains Sand (CPS) is generally found at the Project area in higher-lying areas and is often absent in lower-lying areas. The thickness of the CPS at the Project area ranges from 0 to 75 feet and generally gets thinner toward the western portion of the Project area (Haile 2011).

### Mineralized Zones

*Mineralized zones* are the gold-/silver-bearing portions of bedrock in the Project area that have been surveyed to verify metal-bearing content of a given density. These zones follow along both a southwest-to-northeast and east-to-west axis and are interpreted to slope moderately to steeply to the north or northwest (Hulse et al. 2008). In some locations, there are multiple intervals of layered mineralized zones. The mineralized zones are limited to the Richtex Formation and some portions of the Persimmon Fork Formation. In some places, diabase dikes have intruded through the mineralized zones. The mineralized zones can be seen on Figure 1-6.

### 3.2.2.2 Soils

The Natural Resource Conservation Service (NRCS) has mapped the soil distribution for Lancaster County. The Project area is located in the transition between Upper Coastal Plain and Piedmont sediments (Figure 3.2-2) (NRCS 2011). Ten major soil types, identified as those that represent more than 1 percent of the soil matrix for the site, were identified within the Project area. Upper Coastal Plain sediments are concentrated on the east side of the site and are represented by relatively deep, unconsolidated sands of the Blaney, Blanton, Rutlege, Wagram, and Worsham soil series. The thin silt loams of the Appling and Chesterfield, Chewacla, Herndon, Nason, Vaucluse, and Blaney soil series are situated on the west side of the Project area.

The NRCS also described the soils based on their particle size. Typically, the soils range from sand (larger particle sizes) to the smaller sizes of silt and then clay. *Loams* are soils that are composed of a mixture of sand, silt, clay, and organic matter (decayed plant materials).

The NRCS classifies soils based on their percent slope; how easily the soils may erode, also known as the "K value" (Figure 3.2-3); and their drainage class (Figure 3.2-4). The *percent slope* is a measure of the gradient, or inclination, of the land surface. The percent slope of the soils in the Project area range from the nearly level land at 0 to 3 percent slope of the Upper Coastal Plain complex soils to the hilly ground of the Piedmont complex soils, with slopes of 10 to 25 percent. The drainage class of the soils in the Project area ranges from very poorly drained Upper Coastal Plain soils in the eastern portion of the Project area to the well-drained Piedmont complex soils in the western portion of the Project area. The Upper Coastal Plain complex soils also have lower K values than the Piedmont soils, meaning that they are less susceptible to erosion by water.

The following discussion summarizes the soil types mapped for the Project area, separated based on their belonging to the Upper Coastal Plain or Piedmont grouping.

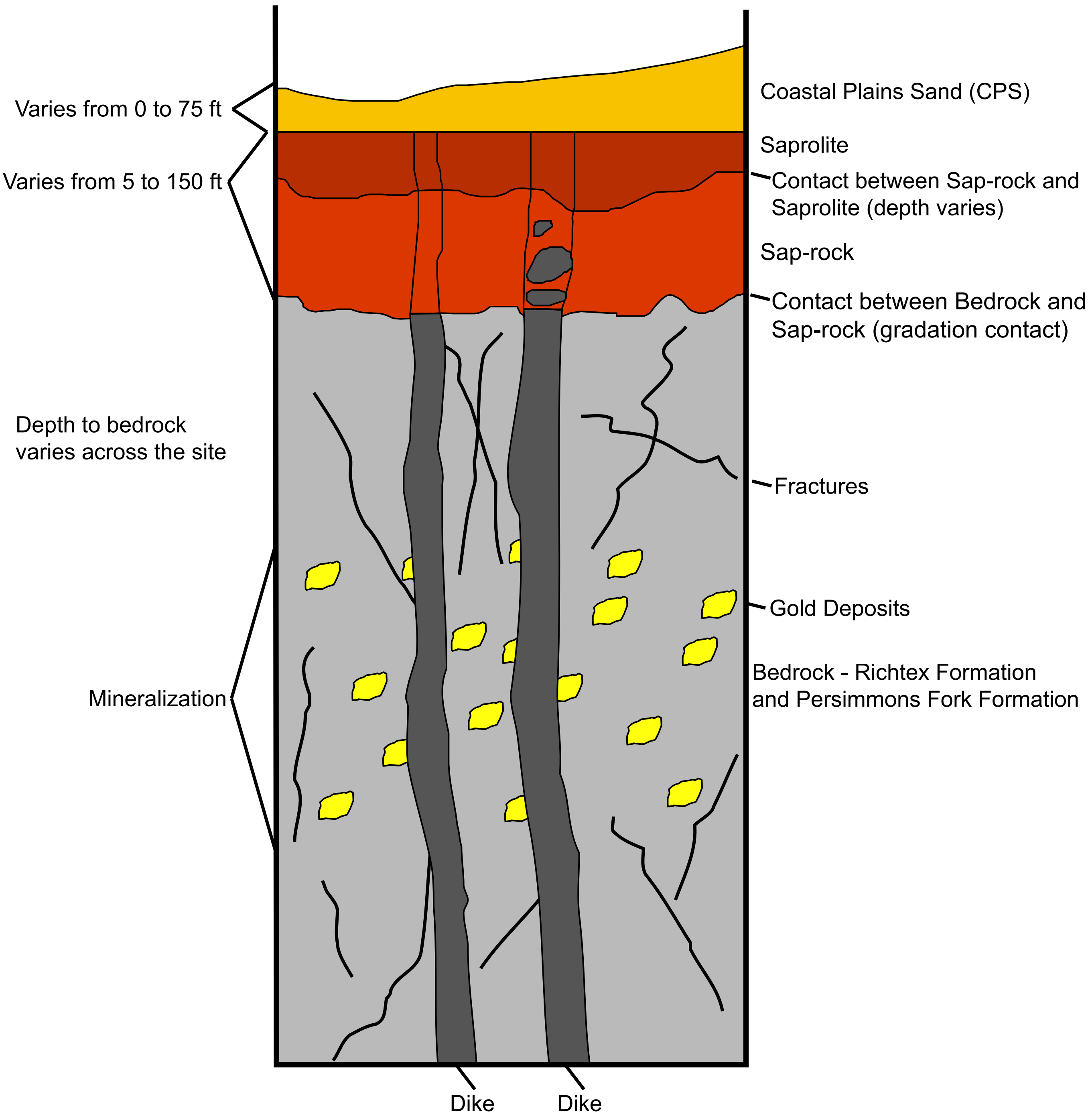


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Figure 3.2-1

**Generalized Stratigraphic Section**

Source: Schlumberger Water Services 2011.

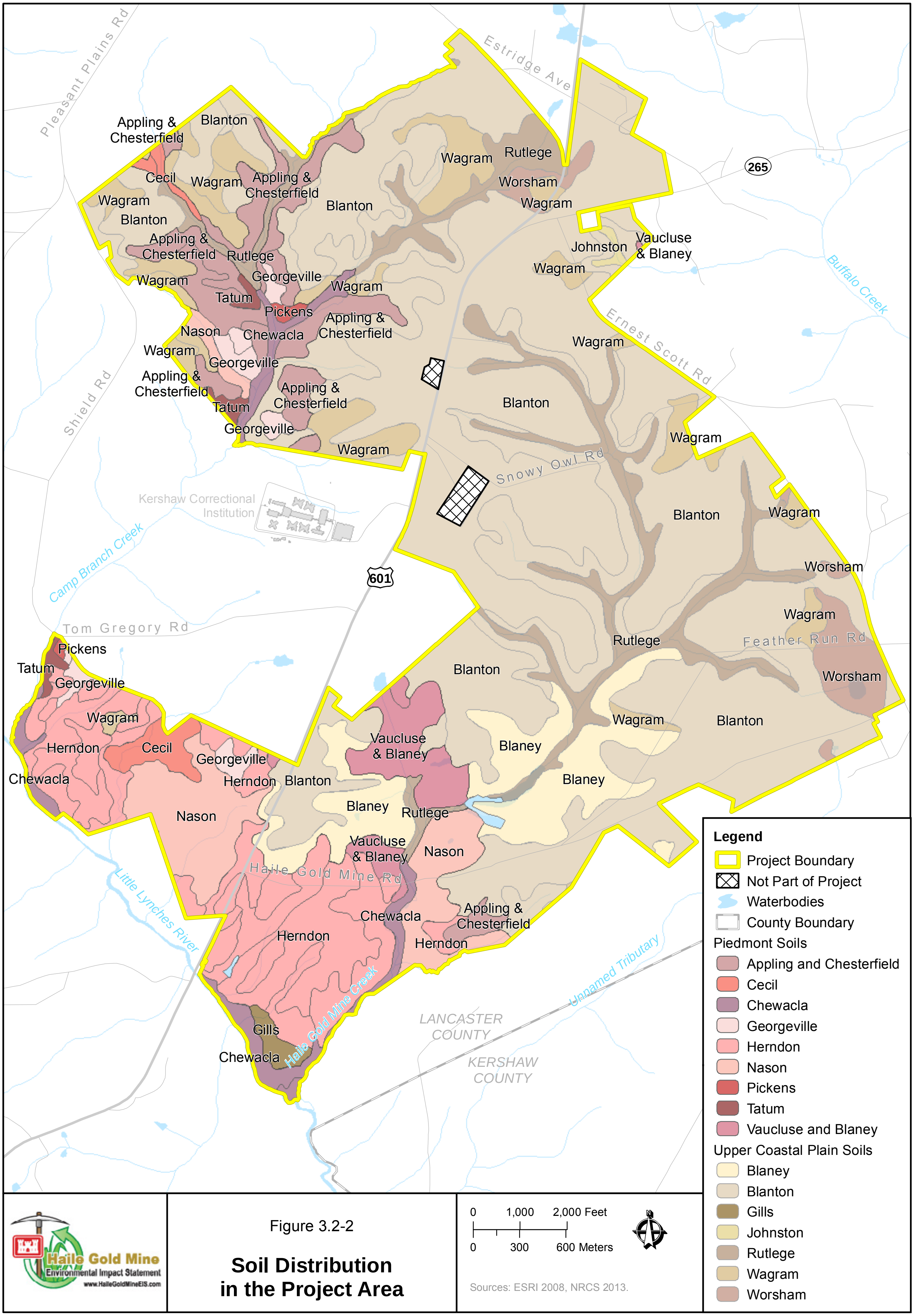


Figure 3.2-2

**Soil Distribution in the Project Area**

Sources: ESRI 2008, NRCS 2013.

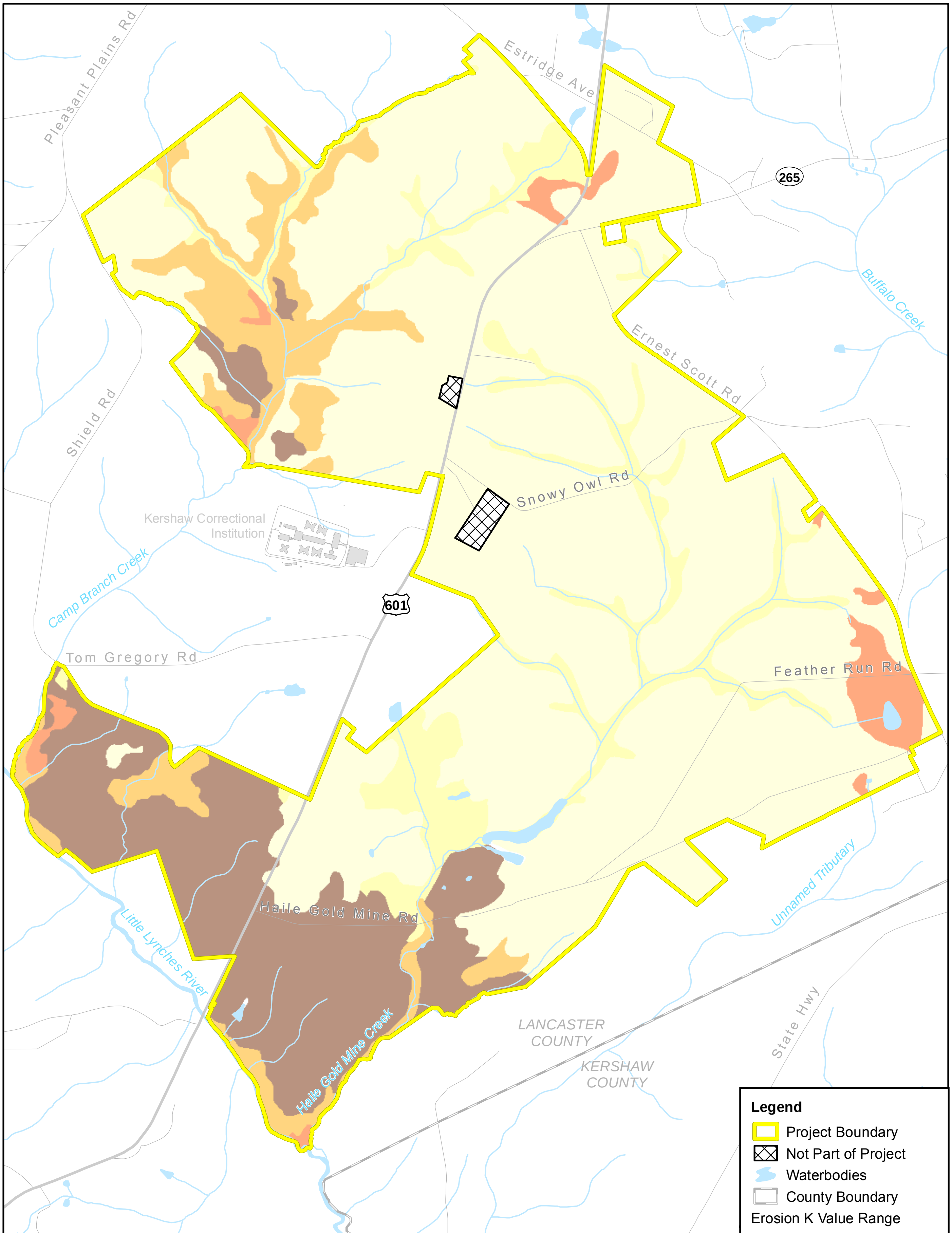


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Figure 3.2-3

**Erosion K Value of Soils in the Project Area**

0 1,000 2,000 Feet
0 300 600 Meters

Sources: ESRI 2008, NRCS 2011.

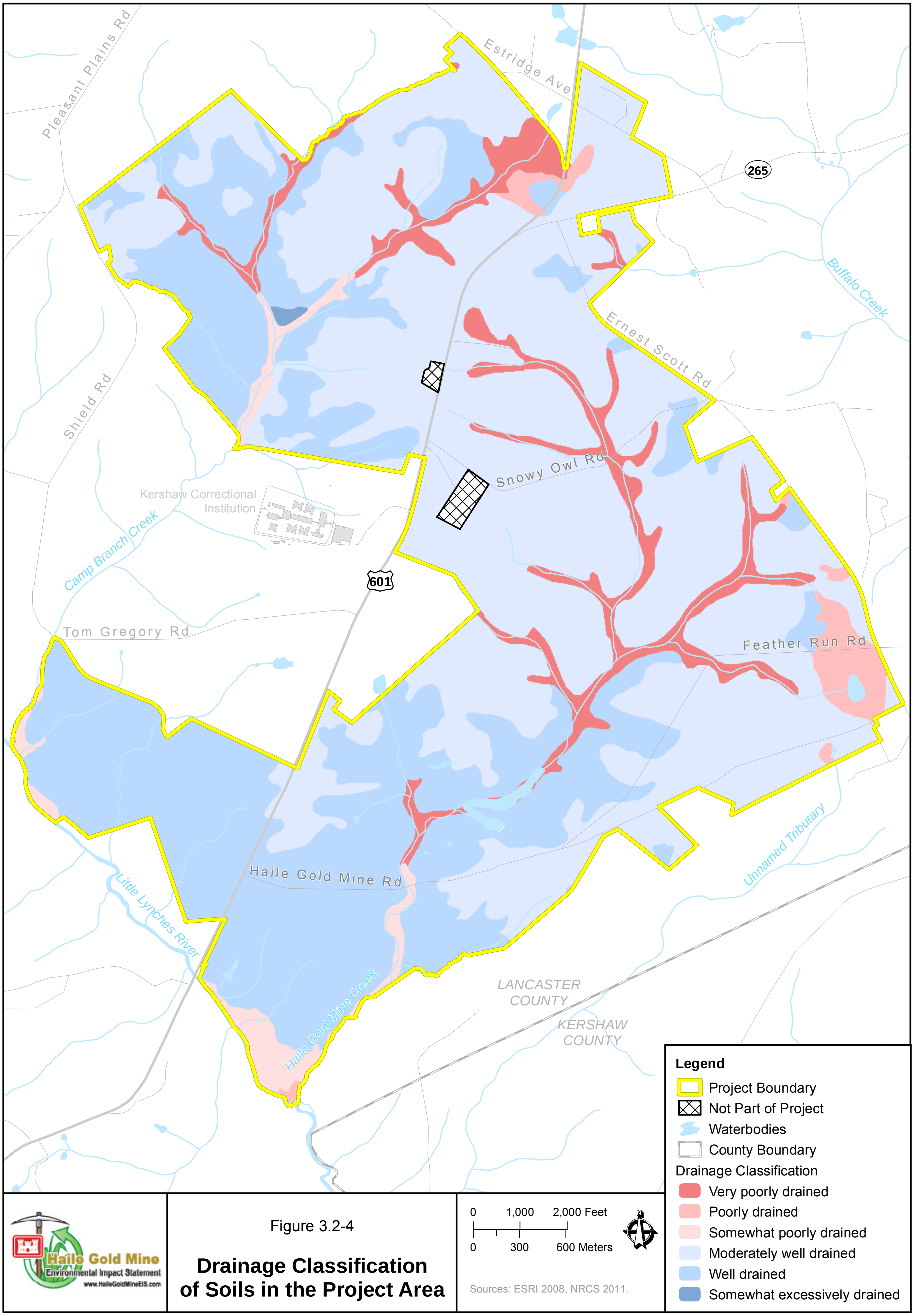


Figure 3.2-4

**Drainage Classification of Soils in the Project Area**

Sources: ESRI 2008, NRCS 2011.

### Upper Coastal Plain Soils

#### *Blaney*

Blaney sands comprise 6.3 percent of the soil in the Project area by area.[1] These sands are found in prehistoric marine terraces and are a mix of sand, clay, silt, and organic matter. They are well drained soils that generally have a low water capacity, able to sustain 4 inches of water. The hazard of water erosion is low to moderate for these soils. Blaney sands are found in areas with a 6- to 10-percent slope.

#### *Blanton*

Blanton sands comprise 51.4 percent of the soil in the Project area. These sands are found in marine terraces and are assumed to have been formed from prehistoric sandy marine deposits. They are moderately well drained soils with a very low water capacity, able to sustain 2 inches of water. The hazard of water erosion is low for Blanton soils. These soils are typically found in areas with a 0- to 6-percent slope and a 6- to 15-percent slope.

#### *Rutlege*

Rutlege loamy sands comprise 7.0 percent of the soil in the Project area. These soils are found in depressions and floodplains and were formed from sandy marine deposits. They are very poorly drained soils with a low water capacity, able to sustain 4 inches of water. The hazard of water erosion is low, and these soils are generally found in flatter areas with a 0- to 2-percent slope.

#### *Wagram*

Wagram sand comprises 6.2 percent of the soil in the Project area. Wagram soils are found in marine terraces and were formed from a mix of marine sands, silts, clays, and organic matter. They are well drained sands with a moderate water capacity, able to sustain 6 inches of water. The hazard of erosion is low, and they are found in areas with a 2- to 6-percent slope, 6- to 10-percent slope, and 10- to 15-percent slope.

#### *Worsham*

Worsham fine sandy loams comprise 1.9 percent of the soil in the Project area. These soils are found in depressions and were formed from clay sediments deposited by running water. The soil is poorly drained, with a moderate water capacity and able to sustain approximately 8 inches of water. The hazard of water erosion is moderate for Worsham soils, and they are found in areas with a 0- to 2-percent slope.

### Piedmont Soils

#### *Appling and Chesterfield*

Appling and Chesterfield soils comprise 4.3 percent of the soil in the Project area. These soils are found on hillslopes and were formed from clay residues of weathered granite. They are well drained soils showing erosion, with a moderate water capacity and able to sustain 8 inches of water. The hazard of water erosion is moderate for these soils. They are found in areas with a 6- to 10-percent slope and a 10- to 15-percent slope.

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[1] Each description of the percentage of soil is expressed by area rather than volume.

#### *Chewacla*

The Chewacla soils comprise 1.8 percent of the soil in the Project area. These soils are found in floodplains and were formed from various sediments deposited by running water. They are somewhat poorly drained soils, with a high water capacity and able to sustain approximately 12 inches of water. The hazard of water erosion is moderate, and Chewacla soils are found in generally flat areas with a 0- to 2-percent slope.

#### *Herndon*

Herndon silt loam comprises 10.2 percent of the soil in the Project area. The silt loam is found on hill slopes and was formed from clay residues of weathered rock. Herndon silt loam is a well drained soil with a high water capacity, able to sustain 10 inches of water. The hazard of water erosion is somewhat high. Herndon soils are found in areas with a 2- to 6-percent slope, 6- to 10-percent slope, and 10- to 15-percent slope.

#### *Nason*

Nason loam comprises 5.2 percent of the soil in the Project area. It is found on hill slopes and was formed from clay residues of weathered rock. Nason loams are well drained soils with a low water capacity, able to sustain approximately 6 inches of water. The hazard of water erosion is high. These soils are found in steeper areas with a 15- to 25-percent slope.

#### *Vaucluse and Blaney*

Vaucluse and Blaney loamy sands comprise 2.4 percent of the soil in the Project area. These soils are found in marine terraces and were formed from marine deposits of clay, silt, sand, and organic matter. They are well drained soils with a low water capacity, able to sustain 5 inches of water. The hazard of water erosion is low to moderate. Vaucluse and Blaney soils are found in areas with moderate slopes of 6- to 10-percent and 10- to 15-percent.

### 3.2.2.3 Waste Rock and Ore Classification

Chemical analysis was conducted to evaluate the acid-forming potential of the rocks that would be excavated as part of the Project (Schafer 2010a, 2010b). The excavated material that becomes waste rock and is not processed at the Mill is referred to as *overburden*. As mining occurs and material is removed from the pits, OSAs would be used to store the overburden and rock that would not be processed to recover gold. The OSAs would be used to segregate the overburden based on its potential for generation of acid mine drainage conditions. As discussed in Appendix A (Section A.4), the chemical analysis classified the rock to be excavated in three categories based on mineralogy and oxidation of certain rock types: red PAG material, yellow PAG material, and green overburden (Schafer 2010a, 2010b). Red PAG is the rock or material produced from the mining process that poses the greatest risk for generating acid mine drainage conditions. Yellow PAG was considered to have a moderate potential for acid mine drainage conditions. Green overburden is considered inert, or with low potential to cause acid mine drainage conditions.

### 3.2.2.4 Seismicity

*Seismicity* describes the relative frequency and distribution of earthquakes. The *magnitude* of an earthquake is measured using a logarithmic scale; it reflects the size of the earthquake and typically the extent of damage that would occur. The Project area is in a region of historically moderate seismic hazard, with relatively low rates of seismicity. Historical seismicity in the vicinity of the Haile Gold Mine was evaluated using the U.S. Geologic Survey (USGS) worldwide earthquake database search for all historical earthquakes with magnitude greater than or equal to 3.0, at a distance of approximately 124 miles from the Project boundary. The database search contains catalogs of earthquakes supplied by various U.S. and worldwide sources, including the Preliminary Determinations of Earthquakes catalog and the catalog of principal earthquakes in the United States.

Earthquakes identified in the historical records from 1817 to the present range from 3.0 to 7.3 in magnitude. Eleven of these earthquakes have been greater than magnitude 4. Two earthquakes were greater than magnitude 5: the 1886 Charleston earthquake at 7.3 magnitude and the 1913 Union County earthquake at 5.5 magnitude. The 1886 Charleston earthquake occurred approximately 118 miles from the Project area. The 1913 Union County earthquake was the closest earthquake to the Project area, with a magnitude greater than 5; it occurred at an approximate distance of 65 miles from the Project boundary. The seismic event closest to the Project area was a 3.5-magnitude earthquake that occurred in April 1998, approximately 3 miles from the Project boundary. To provide a frame of reference, a 3.5-magnitude earthquake is described by the Modified Mercalli scale to produce vibrations similar to the passing of a truck. Most persons do not recognize a 3.5-magnitude seismic event as an earthquake.

### 3.2.3 Literature Cited

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USGS. See U.S. Geological Survey.

# 3.3 Groundwater Hydrology and Water Quality

This section describes the existing groundwater hydrology and water quality in the groundwater study area. The study area for groundwater (Figure 3.3-1) is the area predicted to change as a result of the mine dewatering program from groundwater modeling. See Sections 4.1, “Approach to Environmental Analysis,” and 4.3, “Groundwater Hydrology and Water Quality” for information on the mine dewatering program and groundwater modeling. The groundwater resources within and surrounding the Haile Gold Mine Project site are a source of water supply for agricultural, domestic, industrial and commercial, and public water uses. Groundwater in the study area also emerges in various locations as springs, seeps into wetland areas, and baseflow for streams.

The Haile Gold Mine Project would lower the aquifer level by pumping groundwater to dewater the mine pits. Lowering the groundwater level would result in a number of inter-related impacts, including reduced availability of groundwater supply and reduction of groundwater contributions to surface waters and surface water-related ecosystems. After mining, when pumping ceases, groundwater levels would rebound gradually to approximately pre-mining conditions. Groundwater would flow through the backfilled pits and pit lakes. Flow through these disturbed areas would alter groundwater chemistry and water quality from leaching of mined areas and backfill material. Where groundwater discharges to surface waters, water quality and other water-related resources also would be affected.

This section describes the local and regional hydrogeologic system, and the results of groundwater quality measurements from groundwater wells. For other water-related resources, see specific discussions in Sections 3.4, “Surface Water Hydrology and Water Quality”; 3.6, “Wetlands and Other Waters of the United States”; 3.7, “Aquatic Resources”; and 3.5, “Water Supply and Floodplains.”

## 3.3.1 Regulatory Setting

The following federal and state regulations govern Project-related activities that could affect groundwater in the study area. See Appendix F for further details on regulations that apply to the proposed Project

- **Safe Drinking Water Act** – The Safe Drinking Water Act (SDWA) is the primary federal legislation that regulates the nation’s public drinking water supplies. The USEPA sets drinking water quality standards and oversees implementation of these standards by states, localities, and water suppliers. The USEPA has established maximum contaminant levels (MCLs) that serve as primary drinking water standards and secondary MCLs that relate to the aesthetic characteristics of water such as color, taste, and odor.
- **South Carolina Safe Drinking Water Act –** The SCDHEC Bureau of Water regulates groundwater quality. The SCDHEC considers all groundwater of the state to be a potential source of drinking water after primary treatment.
- **South Carolina Groundwater Use and Reporting Act –** The SCDHEC sets standards and procedures necessary to maintain, conserve, and protect the groundwater resources of the state. Regulation 61-113 requires groundwater withdrawal to comply with permits and other standards.

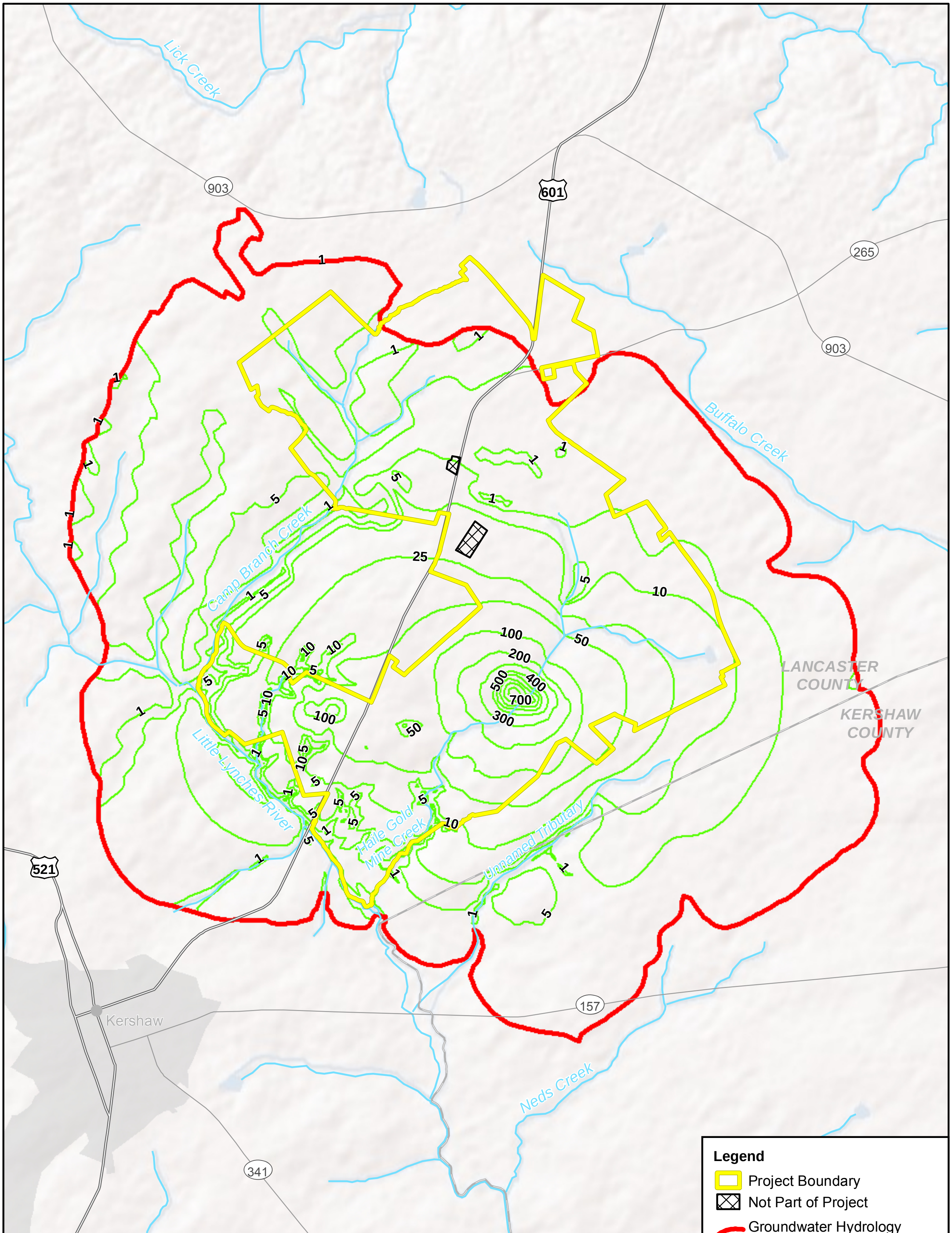


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Figure 3.3-1

**Study Area for Groundwater Hydrology and Water Quality**

0 2,000 4,000 Feet

0 500 1,000 Meters

Source: ESRI 2008.

### 3.3.2 Existing Conditions

#### 3.3.2.1 Regional Setting

The mine is located within the Piedmont physiographic province of the southeastern United States (Figure 3.3-2). The Piedmont physiographic province trends from southwest to northeast and is bounded by the Coastal Plain to the east and the southern Appalachian Mountains to the west. The southeastern Piedmont is characterized by gentle topography and rolling hills, dense networks of stream drainages, and red-brown saprolite soils.

The topography of the Project area is the result of dissection by Haile Gold Mine Creek, a perennial stream that flows from northeast to southwest, and the intermittent tributaries that flow into the creek from the southeast and northwest. Slopes in the drainages are gentle to moderate (from approximately 9 to 13 percent), and upland slopes above the drainages are gentle to nearly flat (up to 1 percent).

The drainage basin of Haile Gold Mine Creek, the primary drainage feature in the Project area, is approximately 4.9 square miles. The basin is comprised of small drainage areas that divide the Project area and drain into the southeast-flowing Little Lynches River that is approximately 1 mile southwest and drains to the Lynches River. The Project area contains reclaimed and revegetated mine features and is wooded with both natural and logged pine and hardwood forests.

The climate is subtropical, with hot and humid summers and daytime temperatures averaging between 86 and 92°F. Precipitation is abundant throughout the year; the wettest months are March and July. The driest months are April, October, and November. Winters are mild and wet, and overnight temperatures often are below freezing. Precipitation is usually rainfall. Measurable snowfalls, which occur a few times each winter, usually total less than 6 inches and do not tend to accumulate on the ground.

The principal aquifer systems of South Carolina are shown in Figure 3.3-3. Recharge to the groundwater system is primarily derived from infiltration of precipitation. The recharge rate to the groundwater system is estimated to be equivalent to between 8 and 10 percent of the annual precipitation (Schlumberger Water Services 2010a; ERC 2012). Groundwater and surface water interact in the regional study area and within the Project boundary. Regional aquifers discharge to streams in the area and thus provide a source of stream baseflow. This groundwater discharge provides a portion of the baseflow in the streams and rivers during all but high flow conditions.

Three major hydrogeologic units are present in the Piedmont physiographic province of South Carolina: fractured crystalline bedrock; the overlying saprolite; and recent alluvial deposits, including the CPS. The CPS aquifer is unconfined and generally is directly connected to surface water features. The groundwater table generally reflects topography, with depths to groundwater typically less than 30 feet. Where present, the saprolite unit partially separates the CPS aquifer from the underlying bedrock aquifer; however, work in the Project area has indicated that the saprolite is not an effective confining unit and does allow vertical flow. The bedrock aquifer has low intrinsic permeability, and water occurs only in fractures within the rock (Newcome 2002). The groundwater flow properties of these hydrogeologic units have been characterized for the Haile Gold Mine site and for the nearby Brewer and Ridgeway Mines, located approximately 8 miles northeast and approximately 30 miles southwest of the Haile Gold Mine, respectively.

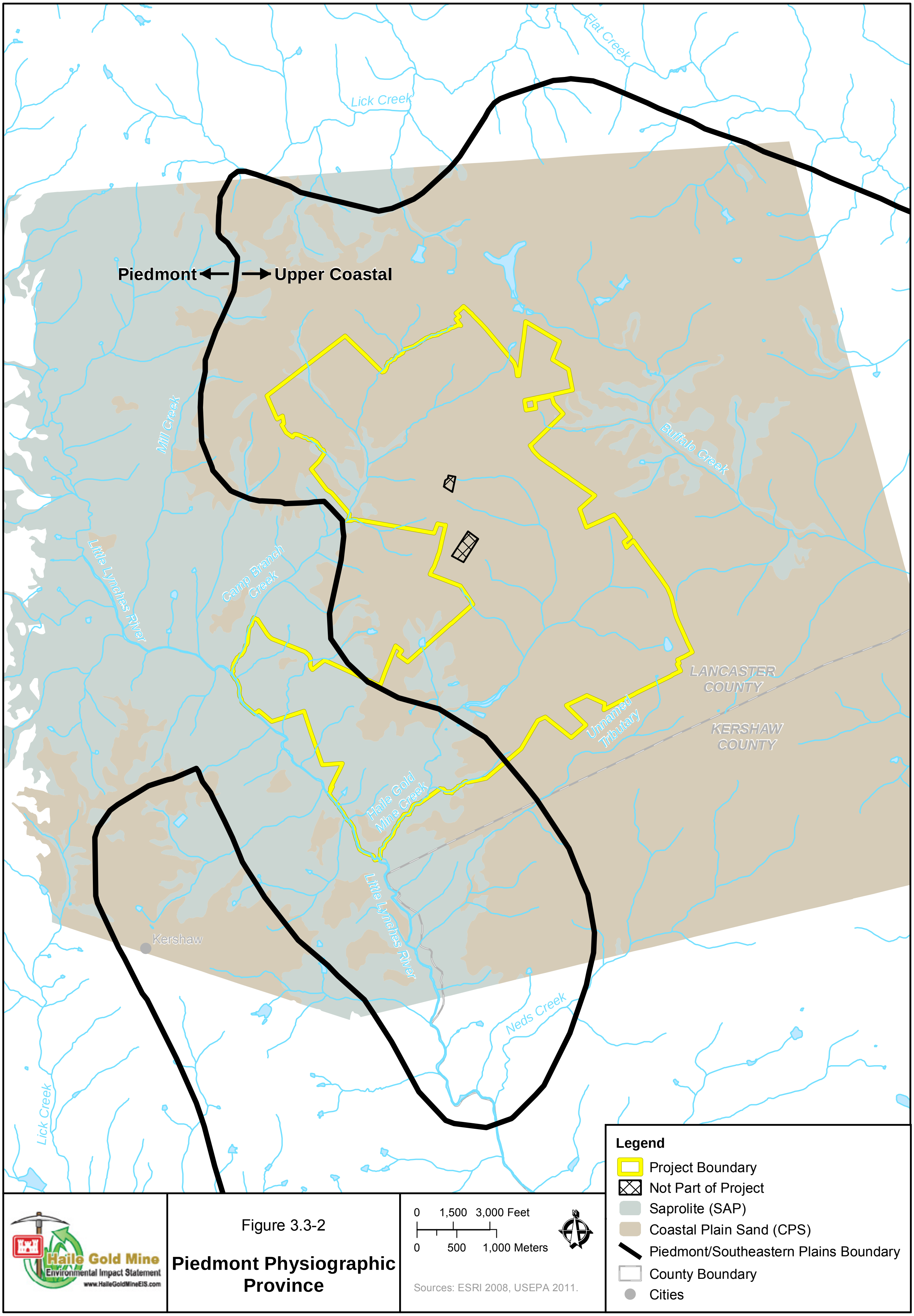


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Figure 3.3-2

**Piedmont Physiographic Province**

Sources: ESRI 2008, USEPA 2011.

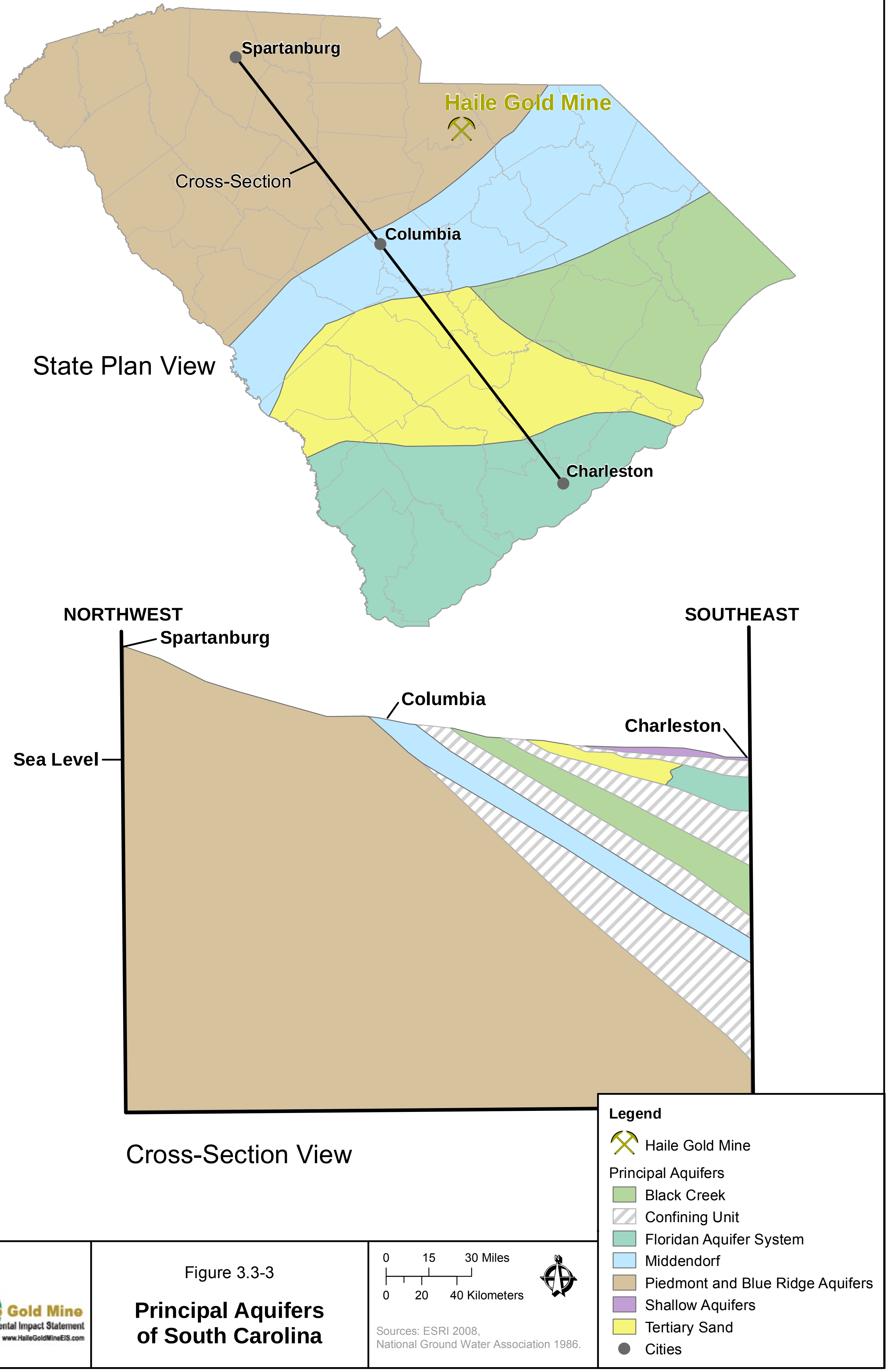


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Figure 3.3-3

**Principal Aquifers of South Carolina**

Sources: ESRI 2008,
National Ground Water Association 1986.

#### 3.3.2.2 Project Site Hydrogeology and Aquifers

The characteristics of the local water-bearing zones at the Haile Gold Mine are similar to regional characteristics (see Figure 3.3-3).

## Coastal Plains Sand Aquifer

The CPS aquifer occurs in the higher elevations of the Project area. It varies in thickness and is absent in all of the major drainages of the Project area (Schlumberger Water Services 2010a). Where it occurs, the CPS aquifer is unconfined, less than 30 feet below ground surface (bgs), and recharges surface waters. There is also downward flow from the CPS aquifer to the underlying saprolite zone. The flow direction within the CPS aquifer generally mimics local topography.

The CPS aquifer has been divided into three parts, the upper CPS, middle CPS, and lower CPS units.

### *Upper CPS Unit*

The upper CPS unit is composed of tan-colored, clean, poorly graded quartz sand. The hydraulic characteristics of the CPS were estimated from laboratory analysis of soil samples collected from test pits that were excavated as part of a previous site geotechnical investigation. The hydraulic conductivity values range between 1.1x10-4 and 9.3x10-4 centimeters per second (cm/s). These values represent the hydraulic conductivity in the vertical direction (Kv). The upper CPS is saturated in some locations at the site. Depending on the thickness and topography, the upper CPS may be saturated.

### *Middle CPS Unit*

The middle CPS unit is composed of white to red quartz sand with clay and some silt. No hydraulic conductivity tests for this unit were reported; however, based on its lithology, hydraulic properties are expected to be similar to those of the upper CPS.

### *Lower CPS Unit*

The lower CPS unit is composed of iron-oxide-cemented coarse gravel and sand [ferricrete], and contains fragments of quartz veins. The bottom of the lower CPS unit is characterized as oxide-cemented coarse gravel and sand. The contact with the underlying saprolite is marked by a layer of red-brown ferricrete containing quartz vein fragments. The observed conditions indicate that rain water likely percolates down through the CPS and travels horizontally along this contact.

No hydraulic test data are available on the ferricrete layer. However, the permeability of this layer appears to be low, as indicated by seeps that occur at the base of the lower CPS unit. The seeps provide baseflow recharge to upper Haile Gold Mine Creek. Fracturing in the ferricrete layer is evident, and this presents a likely pathway for groundwater flow from the lower CPS unit to the underlying saprolite.

## Saprolite

A thick layer of saprolite overlies the bedrock in the majority of the Project area. Saprolite forms by the chemical weathering of the Carolina Slate Belt bedrock material. In the Project area, it is a red-brown to white, dense, unconsolidated, kaolin-rich clay, up to 175 feet thick. Although the saprolite generally consists of clay with low primary permeability, it is cut by numerous quartz-rich dikes. The dikes are intensely fractured, and tests of hydraulic permeability conducted on the site indicate that they act as conduits for vertical flow through the saprolite. As a result, the saprolite has higher vertical hydraulic conductivity than expected and is not an effective confining unit in spite of the clay-rich matrix of the unit.

Monitoring wells completed within the saprolite in the Project area typically were reported to be dry immediately after installation of the well but recharged over a period of 3–6 days (Schlumberger Water Services 2011). Based on in-situ constant and falling head and slug tests, the hydraulic conductivity values of the saprolite unit ranged between 0.17 and 0.3 ft/day (1.0x10-5 to 6.0x10-5 cm/sec), with an average value of 0.10 ft/day (3.5x10-5 cm/sec) (Schlumberger Water Services 2011). Hydraulic conductivity estimates from pumping test data ranged from 0.15 to 1.39 ft/day (5.3x10-5 to 4.9x10-4 cm/sec).

### Sap-Rock Zone

As the weathered saprolite grades downward to unweathered bedrock, the degree of weathering becomes less and less. This transition zone from weathered clay to unweathered bedrock is known as the sap-rock zone and is present across the Project area. The thickness of the sap-rock zone is variable and is a function of the downward advance of the weathering process. Geophysical well logs indicate that, like the saprolite zone, the sap-rock zone contains horizontal fractures that act as permeable groundwater flow zones. Preliminary results indicate that this zone may be the primary groundwater production zone in and near the Project area.

### Bedrock Aquifer

The water-bearing formation in the region is the Piedmont bedrock, which is collectively referred to in this report as the “bedrock aquifer” or the “crystalline bedrock aquifer.” Groundwater yield from the bedrock system varies greatly, depending on the number of joints and fractures intersected by individual wells and on the extent of the fracture system. The bedrock aquifer has low intrinsic permeability, and water occurs only in fractures within the rock. An analysis of the distribution of fractures and rock quality density indicates that the fracture density is higher in the upper 300 to 400 feet of the bedrock and that the hydraulic conductivity of the deep bedrock system is generally at least ten times lower than the weathered bedrock system. There is some evidence of localized fracturing at depth, where hydraulic conductivity is also relatively high (Schlumberger Water Services 2010a; AMEC 2012).

In 2013, new field data were collected, including new piezometers, wells, and aquifer pumping tests, to better define the characteristics of the bedrock aquifer. The hydraulic conductivity of the bedrock was estimated from falling head slug tests, airlift tests, and pumping test data collected from existing bedrock monitoring wells, new bedrock monitoring wells, and a 10-day aquifer test completed on the test production well (PW-09-01). The hydraulic conductivity from the slug test data ranged from 0.15 to 73.7 ft/day (5.3x10-5 cm/s to 0.026 cm/s), with variability being a function of fracture intensity along the completed intervals. The average hydraulic conductivity for the bedrock was estimated at 2.4 ft/day (8.4x10-4 cm/s) (Schlumberger Water Services 2011). The conductivity of the bedrock was calculated from the PW-09-01 pumping tests conducted in 2012 (AMEC 2012). These values ranged from 0.60 to 0.85 ft/day (2.1x10-4 to 3.0x10-4 cm/sec), with an average value of 0.68 ft/day (2.4x10-4 cm/sec).

The hydraulic conductivity of the bedrock aquifer at the Brewer Mine was estimated at 0.0005 to 0.11 ft/day (1.8x10-7 to 3.9x10-5 cm/sec) (Schlumberger Water Services 2010b) and was estimated at 1.5 to 6.8 ft/day (5.3x10-4 to 2.3x10-3 cm/sec) at the Ridgeway Mine (Schlumberger Water Services 2010b). These values demonstrate that the hydraulic conductivity of the bedrock aquifer in the Project area is consistent with the values at the other two mines, and that the hydraulic properties reported are typical for the bedrock aquifer.

Typical residential wells in the Piedmont area yield between 2 and 5 gallons per minute (gpm). Yields of 4 to 170 gpm have been reported. Groundwater production is generally from the upper 100 feet of the bedrock aquifer, although site data indicate that deeper permeable zones are present. Groundwater quality is reported as good; the most common problem reported was low pH due to minimal natural alkalinity present in the bedrock.

### 3.3.2.3 Groundwater Hydrogeology

#### Groundwater Recharge and Discharge

Recharge to the groundwater system primarily is derived from rainfall (infiltration of precipitation). The recharge rate to the groundwater system is estimated to be equivalent to between 8 and 10 percent of the annual precipitation (ERC 2012). Regional aquifers discharge to streams in the area and thus provide a source of stream baseflow. The regional aquifers are recharged by infiltration of precipitation.

#### Groundwater Levels and Movement

Depths to groundwater tend to follow the topography in the Project area; groundwater is generally shallower in topographically low areas and deeper in topographically high areas. Flow directions tend to follow the local surface topography (Figure 3.3-4). Interpretation of the data suggests a general southwest groundwater flow direction following the drainage.

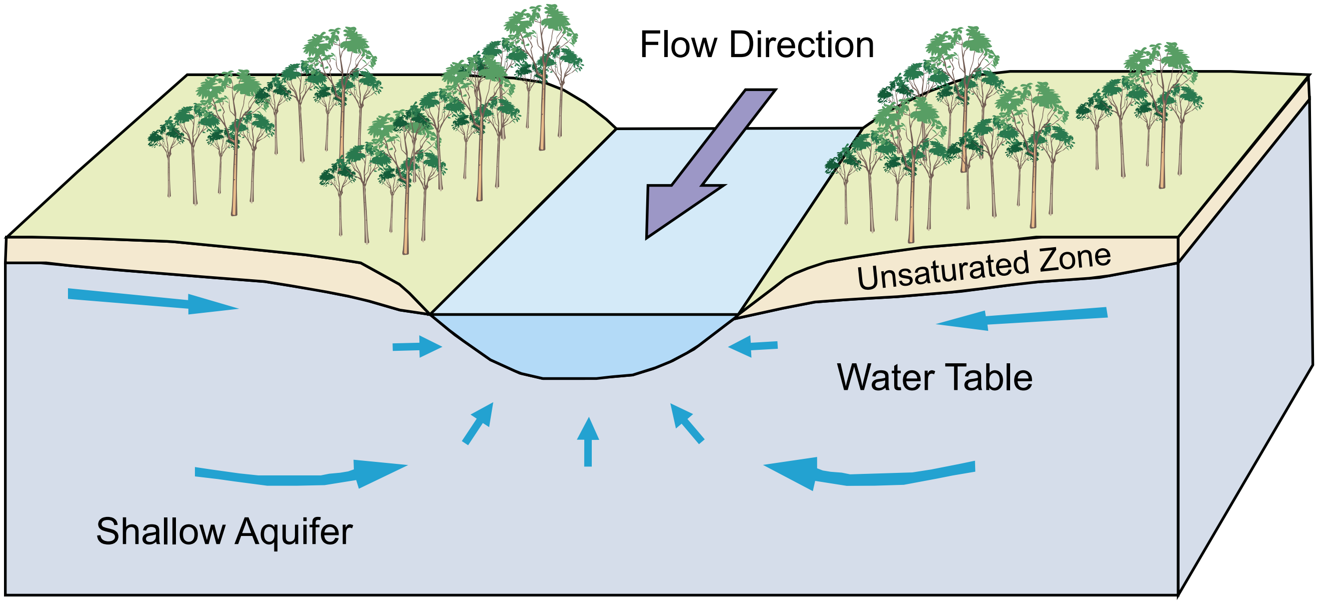
The elevation of groundwater in the bedrock aquifer ranges from approximately 380 to 510 feet msl across the site (Schlumberger Water Services 2010a; AMEC 2012). A bedrock groundwater elevation contour map indicating horizontal gradients across the site is presented in Figure 3.3-5.

Hydraulic gradients indicate pressure difference over a unit length and allow assessment of flow direction. Hydraulic gradients (horizontal or vertical) are calculated by taking the change in water elevation/pressure at two locations divided by the distance between the two locations. Groundwater flows from locations with high elevation/pressure to locations with lower elevation/pressure.

Vertical groundwater gradients prior to the start of the extended-duration pumping test were calculated for each of the multi-completion piezometers on the Site. Gradient results suggest a general downward gradient for most of the Site, indicating flow from the upper bedrock down to the lower bedrock. It has been speculated that the vertical gradients may have resulted from dewatering of the deep bedrock unit caused by air rotary drilling at locations on the Site during the period of measurement (Schlumberger Water Services 2011).

Upward gradients were observed in two piezometers completed in the saprolite and in one piezometer completed in the bedrock zone. These piezometers generally are located along the valley, suggesting possible upland recharge influence and the occurrence of groundwater discharge along Haile Gold Mine Creek.

Horizontal gradients were calculated from the groundwater contour map that was based on earlier data and is presented in Figure 3.3-5. Horizontal gradients ranged from 0.0097 ft/ft in upper Haile Gold Mine Creek area, to 0.0206 ft/ft in lower Haile Gold Mine Creek area, to 0.0356 ft/ft in the North Fork of Haile Gold Mine Creek area, and 0.0542 ft/ft in the south portion of the Project area toward Ledbetter Reservoir. These gradients are typical for moderately permeable aquifer units.



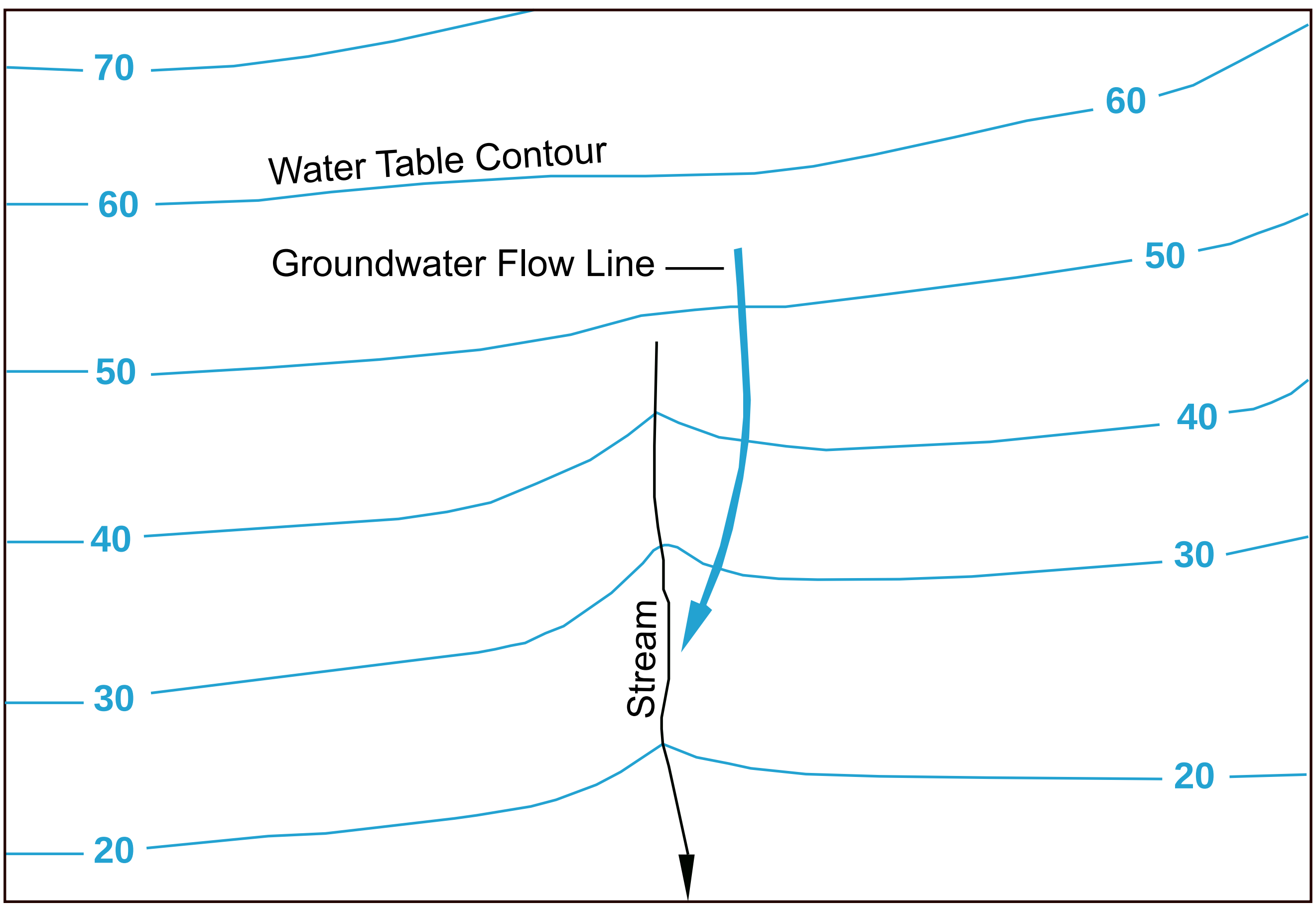




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Figure 3.3-4

**Depth to Groundwater**
**(Haile Gold Mine Project Area)**

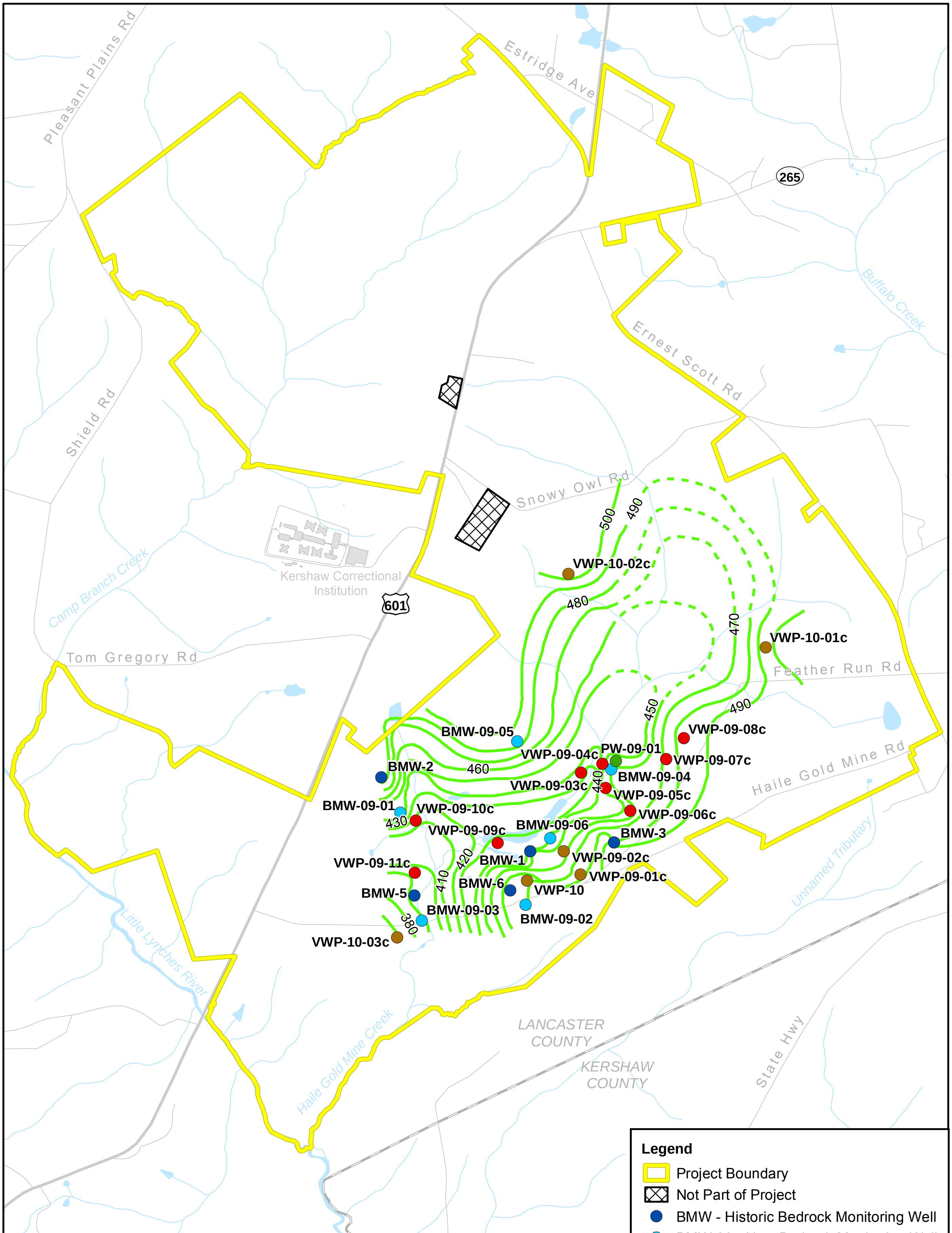


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Figure 3.3-5

**Bedrock Groundwater Elevations**

0 1,000 2,000 Feet

0 300 600 Meters

Sources: ESRI 2008, Schlumberger 2013.

### Variation in Groundwater Levels

Historical data on the variation in groundwater levels in and around the Project area are limited. Although there was no consistent data set from a single set of wells for the entire period of record, the available data were sufficient to determine the typical range in water levels in the aquifers. Water levels in these wells fluctuated approximately 10 feet on average during the period of record (Figure 3.3-6). Water levels were observed to rise quickly in response to periods of higher precipitation and to drop quickly during dry periods, indicating that all the aquifers were closely tied to local recharge.

### Site-Scale Structures

The effects of site-scale structures on groundwater flow were evaluated using available hydrogeologic and geologic data and data obtained from the pumping tests. Lamprophyre and diabase dikes are the dominant structural features at the site.

These dikes have the potential to form groundwater flow barriers locally within the bedrock aquifer. Due to weathering of the dikes near the surface, however, it is unlikely that groundwater flow is affected by the dikes near ground surface (within the saprolite and sap-rock zone). Anecdotal evidence from exploration drilling activities suggests that the bedrock in margins around the dikes has been altered to a brittle state and has increased fracture intensity. The fracture intensity adjacent to the dikes may create conduits of flow along the strike of the feature where fractured; where fracturing is less pronounced, the dikes may restrict groundwater flow (Golder Associates 2010).

### Groundwater/Surface Water Interactions

Groundwater generally flows from recharge in the upland areas of a watershed to discharge areas that are typically surface waterbodies. Where groundwater is shallow, it can flow in to streams, providing base flow (Figure 3.3-7).

Discharge to surface water provides the baseflow to Haile Gold Mine Creek and other surrounding creeks. The distribution of discharge to Haile Gold Mine Creek is variable along the run of the creek and is controlled by the hydraulic conductivity of the aquifer and its connection to surface waters. The magnitude of groundwater discharge from the bedrock aquifer to the surface water system is partially determined by the continuity of the saprolite layer and the vertical hydraulic conductivity of the unit. The thickness of the saprolite unit is known to vary across the site and is absent in some locations.

## 3.3.2.4 Groundwater Quality

Groundwater quality in the study area must comply with federal primary and secondary drinking water standards and applicable MCLs set by the USEPA and implemented by SCDHEC regulations. Because the entire study area must meet drinking water standards, sample results from monitoring wells are compared to these levels for reference. In determining Project-related impacts, the background water quality also is considered as a significance criterion. That is, if a Project related impact exceeds the MCLs but is less than the background, the impact is considered minor because there would not be a reasonable potential to degrade existing water quality. Appendix I includes a detailed summary of the groundwater quality database.

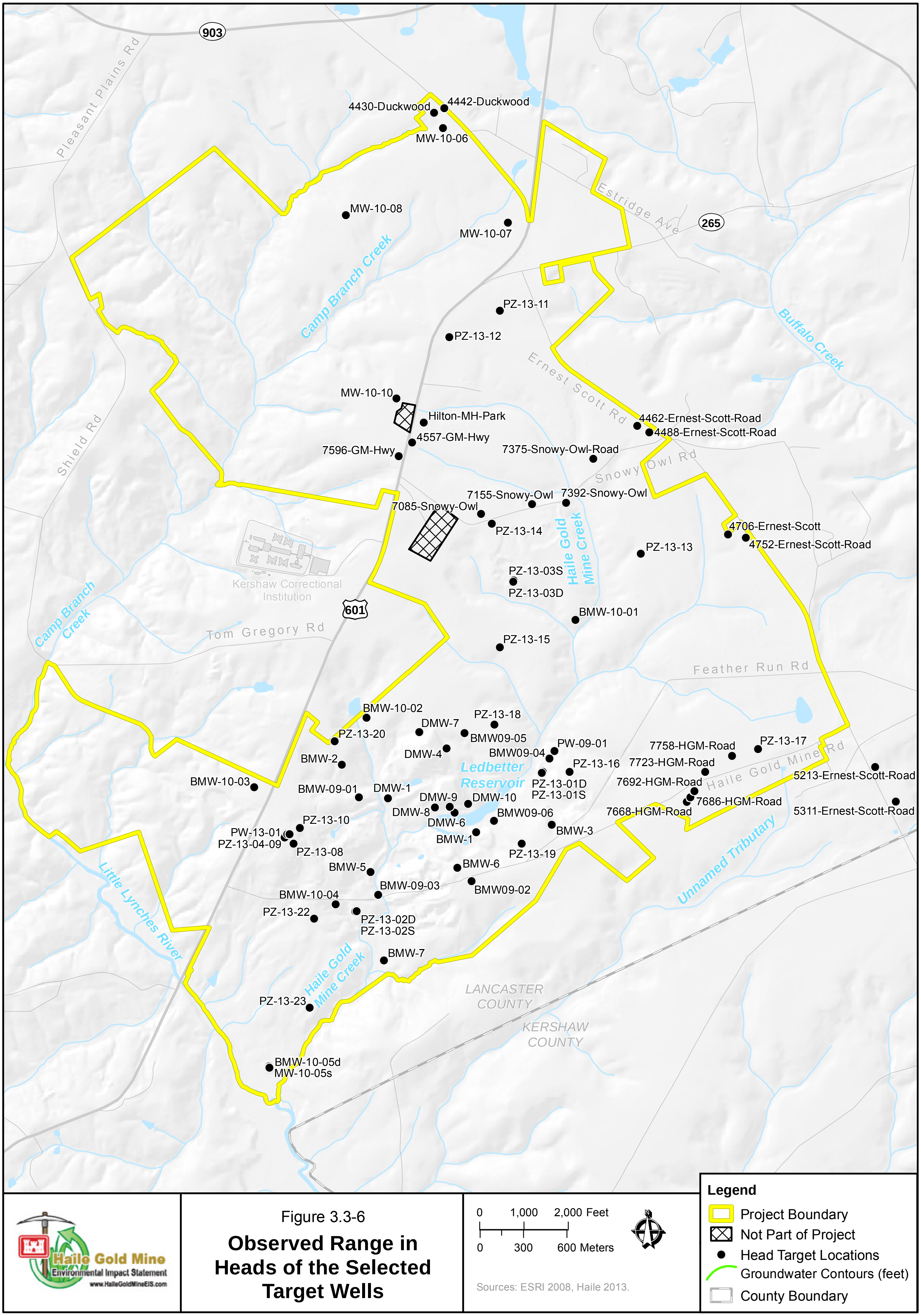
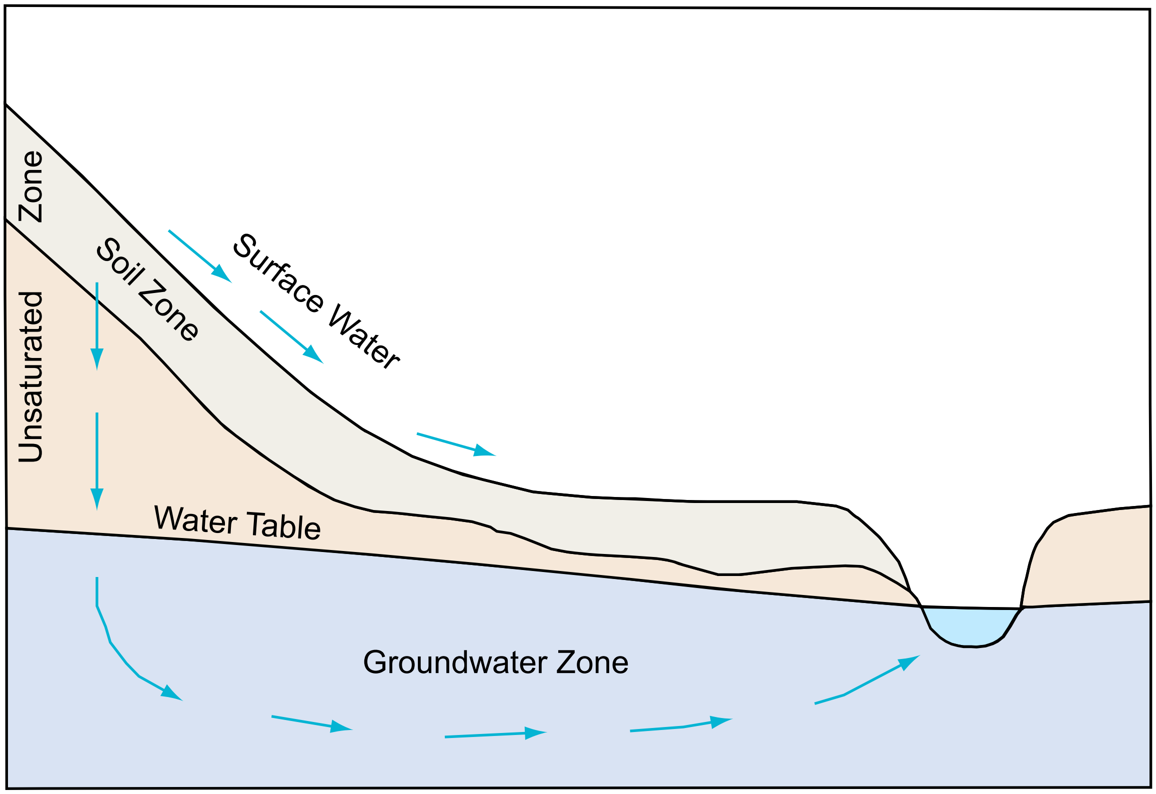



Figure 3.3-6

**Observed Range in Heads of the Selected Target Wells**



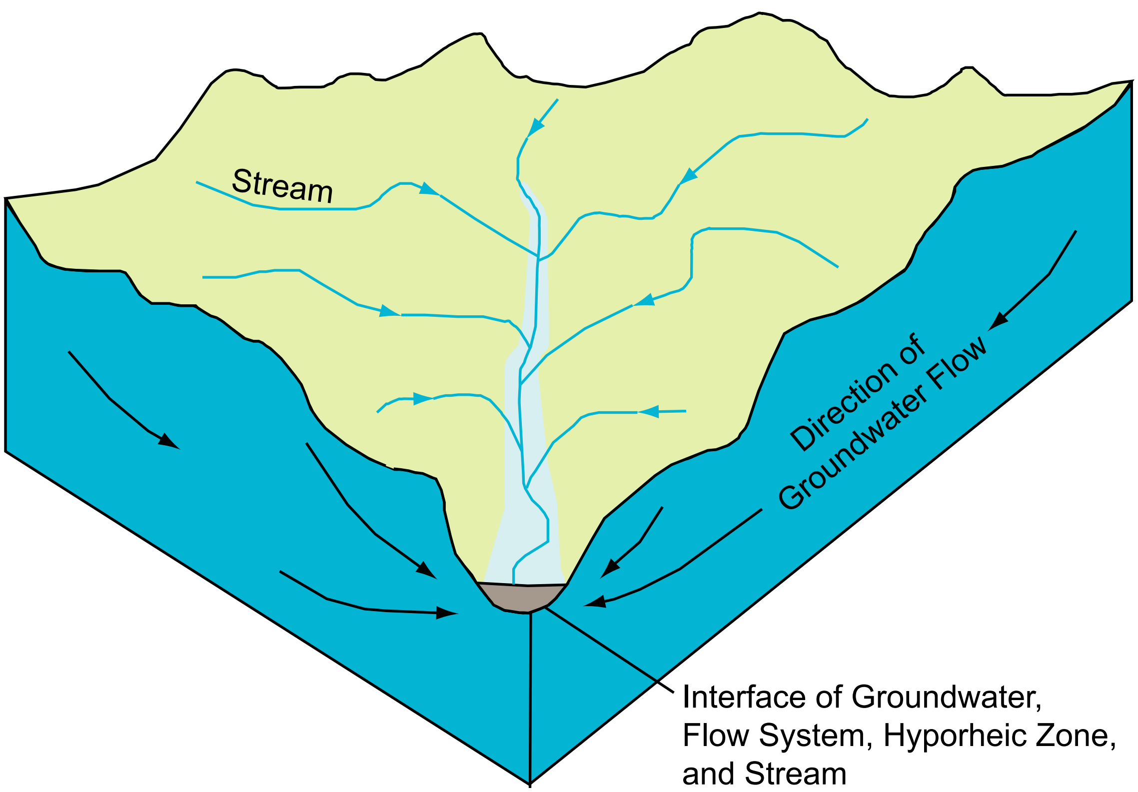




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Figure 3.3-7

**Groundwater-Surface Water Interactions**

Source: USGS 1998.

### Trends in Groundwater Quality

An early set of seven baseline monitoring wells (BMWs) were installed in the bedrock aquifer (approximately 340 feet bgs) in the study area (Schlumberger Water Services 2010a) (Figure 3.3-8). These early wells were designated as BMW-01 through BMW-07. In fall 2009, six new baseline monitoring wells (BMW-09-01 through BMW-09-06) were installed. These wells were installed deeper than previous monitoring wells to better characterize the deep bedrock groundwater in the study area. Samples were not collected from 1996 to 2008 because the mine was in care and maintenance mode. Groundwater sampling resumed in July 2008 at BMW-09-01 through BMW-09-06 (Schlumberger Water Services 2010a).

There are no monitor wells screened in the CPS aquifer or the saprolite unit. Accordingly, the discussion of water quality focuses on the bedrock units of the study area that would be affected by mine operations.

Based on the major components identified in groundwater in the study area, most of the groundwater samples from the 2008 to 2010 sampling events (including the samples from BMW-09-01, BMW-09-02, BMW-09-03, BMW-09-04, BMW-09-05, BMW-09-06, PW-01, BMW-5 and BMW-7) can be classified as calcium bicarbonate (Ca-$HCO_3$) water. Other water-type classifications are more localized and include calcium-magnesium bicarbonate (Ca-Mg-$HCO_3$) from BMW-1; sodium bicarbonate (Na-$HCO_3$) from BMW-3; calcium sulfate (Ca-$SO_4$) from BMW-2; and magnesium sulfate (Mg-$SO_4$) from BMW-6 (Schlumberger Water Services 2010a).

Groundwater pH is variable across the study area. The pH tends to be greater (more alkaline) in the deeper bedrock; however, this correlation was not as strong during sampling in 2008–2010 (Schlumberger Water Services 2010a).

In the following sections, groundwater quality is described for the lower bedrock, the upper bedrock, and the shallow bedrock units. These represent current conditions as a baseline condition and primarily are based on recent sampling from the lower and upper bedrock units.

### Lower Bedrock Groundwater Quality

This section summarizes the results of groundwater sampling and analysis of the six new wells installed in the deeper bedrock (Schlumberger Water Service 2010a) and is based on data from 2008 and 2010. Samples from two of the monitoring wells in the lower bedrock (BMW-09-01 and BMW-09-06) exceed primary drinking water standards for antimony, iron, and manganese. All other constituents in the six deep wells either were not detected (below laboratory detection limits) or were below drinking water standards. Samples indicate that pH values have remained stable over the 2-year period of monitoring: pH ranged from 5.75 standard units (s.u.) at BMW-09-01 to 8.0 s.u. at BMW-09-02.

The lower bedrock groundwater wells have sporadic detections above the drinking water standard of antimony and arsenic. Specifically, four detections of antimony between 0.005 and 0.009 mg/L at locations BMW-09-01, BMW-09-02, and BMW-09-05, and eight detections of arsenic between 0.002 and 0.02 mg/L at locations BMW-09-01, BMW-09-03, BMW-09-04 and BMW-09-05 have been observed to date (Schlumberger Water Services 2010a). Table 3.3-1 depicts in bold constituents from specific monitoring wells that exceed primary and secondary drinking water standards in the lower bedrock groundwater.

Based on Schlumberger Water Services (2010a), temporal changes in iron, manganese, and sulfate have occurred at each location, suggesting a regional progression in groundwater chemistry. Concentrations for the chemical constituents summarized below are typically greater near previously mined areas.

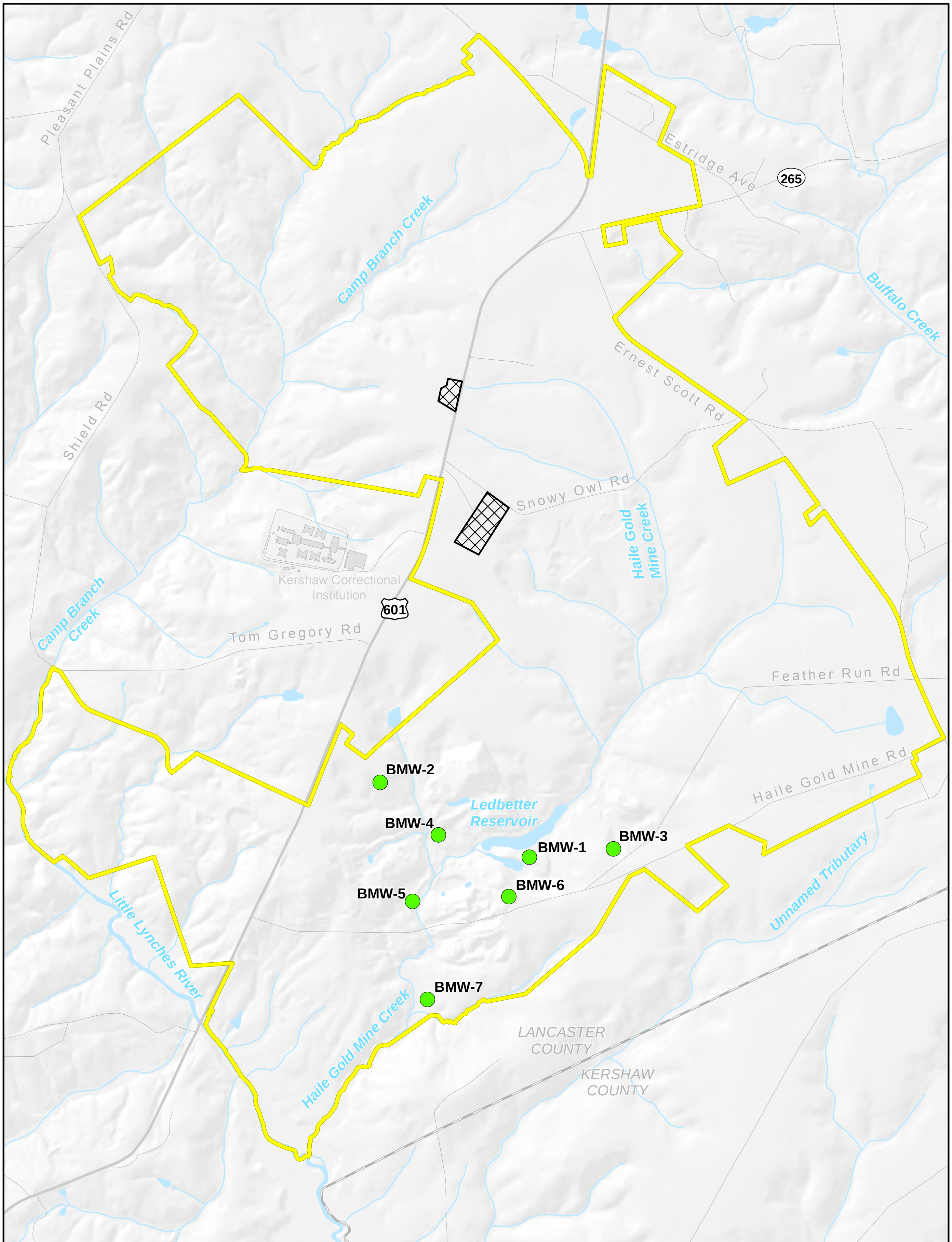


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Figure 3.3-8

**Locations of Baseline Monitoring Wells**

Sources: ESRI 2008, Haile 2013, Schlumberger Water Service 2010a.

**Table 3.3-1 Constituents in Monitoring Wells in Lower Bedrock Groundwater**

| Constituent | Standard (mg/L)[a] | Monitoring Wells in Lower Bedrock Groundwater (2008–2010) | | | | | |
|---|---|---|---|---|---|---|---|
| | | BMW-09-01 | BMW-09-02 | BMW-09-03 | BMW-09-04 | BMW-09-05 | BMW-09-06 |
| Total dissolved solids | 500 | X | X | X | X | X | X |
| Aluminum | 0.05 – 0.2 | ND | **0.11** | ND | ND | ND | ND |
| Antimony | 0.006 | **0.0079** | **0.0089** | ND | ND | **0.0061** | ND |
| Cadmium | 0.005 | ND | ND | ND | ND | ND | ND |
| Cyanide-WAD[b] | 0.0052 | ND | ND | ND | ND | ND | ND |
| Lead | 0.015 | ND | ND | ND | ND | ND | ND |
| Sulfate | 250 | X | X | X | X | X | X |
| Iron | 0.3 | **0.34** | X | **0.57** | **1.6** | **0.39** | ND |
| Manganese | 0.05 | **0.48** | **0.17** | **0.46** | **0.85** | **0.61** | **0.20** |
| Mercury | 0.002 | X | ND | ND | X | ND | X |
| Nitrate as N | 10 | ND | ND | ND | ND | ND | ND |
| Selenium | 0.5 | ND | ND | ND | ND | ND | ND |

Notes:

X Indicates that sample is below primary and secondary drinking water standards

ND = non-detect; samples are below laboratory detection limits.

**Bold font** indicates a constituent that exceeds primary and secondary drinking water standards in the lower bedrock groundwater.

[a] Primary and secondary drinking water standards established by the South Carolina Department of Health and Environmental Control; all units are in mg/L.

[b] Cyanide-WAD (weak acid dissociable cyanide) refers to those cyanide species measured by specific analytical techniques.

Source: Schlumberger Water Services 2010a.

## Upper Bedrock Groundwater Quality

Results from monitoring wells from the upper bedrock groundwater formation are summarized in Table 3.3-2. The data summarized in this section were taken from baseline data statics for samples collected between 2008 and 2010. Cyanide-WAD (weak acid dissociable cyanide) and nitrate exceeded the drinking water standards in well BMW-03 and BMW-02, respectively. Iron and manganese were also shown to exceed the drinking water standards in most samples. All other constituents were either non-detect or below primary drinking water standards.

From 1995 to 2008, concentrations of iron and manganese have increased in monitoring well BMW-05 and decreased at well BMW-06. Sulfate concentrations also have increased in BMW-05 from 1995 to 2008. A minimum pH of 4.98 s.u. was measured at BMW-06, and a maximum field pH of 7.09 s.u. was measured at BMW-03.

### Table 3.3-2 Constituents in Monitoring Wells in Upper Bedrock Groundwater

| Constituent | Standard[a] (mg/L) | Monitoring Wells in Upper Bedrock Groundwater (2008–2010) | | | | | |
|---|---|---|---|---|---|---|---|
| | | BMW-01 | BMW-02 | BMW-03 | BMW-05 | BMW-06 | BMW-07 |
| Total dissolved solids | 500 | X | X | X | X | X | X |
| Aluminum | 0.05 – 0.2 | ND | ND | ND | ND | ND | 0.052 |
| Antimony | 0.006 | ND | ND | ND | ND | ND | ND |
| Cadmium | 0.005 | ND | ND | ND | ND | ND | ND |
| Cyanide-WAD[b] | 0.0052 | ND | ND | **0.01** | ND | ND | ND |
| Lead | 0.015 | ND | ND | ND | ND | ND | ND |
| Sulfate | 250 | X | X | X | X | X | ND |
| Iron | 0.3 | **8.6** | **1.8** | **2.1** | **1.2** | **2.4** | X |
| Manganese | 0.05 | **0.63** | **0.25** | **0.54** | **0.61** | **0.24** | **0.16** |
| Mercury | 0.002 | ND | ND | ND | ND | ND | ND |
| Nitrate as N | 10 | X | **98** | X | ND | ND | ND |
| Selenium | 0.5 | ND | ND | ND | ND | ND | ND |

Notes:

X Indicates that sample is below primary and secondary drinking water standards.

ND = non-detect; samples are below laboratory detection limits.

**Bold font** indicates a constituent that exceeds primary and secondary drinking water standards in the upper bedrock groundwater.

[a] Primary and secondary drinking water standards established by the South Carolina Department of Health and Environmental Control; all units are in mg/L.

[b] Cyanide-WAD (weak acid dissociable cyanide) refers to those cyanide species measured by specific analytical techniques.

Source: Schlumberger Water Services 2010a.

## Shallow Bedrock Groundwater Quality

Within the shallow bedrock formation, no laboratory analyses of water samples was conducted in the 2008 to 2010 period; however, water quality was characterized with field measurements. None of these field data apply to drinking water standards. As such, this unit is described using historical data in the following section.

Table 3.3-3 depicts exceedances of primary drinking water constituents from 1993 to 2010, which include shallow bedrock samples from 2008 to 2010. Primary drinking water standards were exceeded more frequently early in the period from 1993 to 2010 because Haile Gold Mine used open-pit mining and heap leach gold recovery until 1991 and continued residual gold recovery until 1992 (Schlumberger Water Services 2010a).

Ten groundwater monitoring wells were installed in the shallow bedrock unit as part of SCDHEC compliance monitoring wells (DMW prefix) within and adjacent to the Study Area. Monitoring wells DMW-1 through DMW-7 were installed between October 1988 and October 1990 to obtain wastewater treatment plant construction permits for the mine. Wells DMW-8 to DMW-10 were installed during April 1998 to replace three South Carolina Land Resource Conservation Commission wells intended for leach pad monitoring. Table 3.3-3 depicts in bold primary drinking water exceedances sampled from 1993 to 2010 in shallow bedrock groundwater. Recent sampling (2008–2010) from DMW wells were analyzed in the field only for electrical conductivity, water level, dissolved oxygen, pH, and temperature; laboratory analysis was not done for any shallow groundwater samples from DMW wells.

**Table 3.3-3 Constituents in Monitoring Wells in Shallow Bedrock Groundwater**

| Constituent | Standards[a] (mg/L) | Monitoring Well Shallow Bedrock Groundwater (1993–2010) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | DMW-1 | DMW-2 | DMW-4 | DMW-5 | DMW-6 | DMW-7[b] | DMW-9 |
| Total dissolved solids | 500 | **784** | **1021** | X | **3300** | **969** | X | NS[a] |
| Aluminum | 0.05 – 0.2 | **0.85** | **0.6** | **14.5** | **4.56** | **3.33** | **0.6** | NS |
| Antimony | 0.006 | NS | NS | NS | NS | NS | NS | NS |
| Cadmium | 0.005 | **0.007** | **0.006** | **0.01** | **0.01** | **0.02** | X | NS |
| Cyanide-WAD[c] | 0.0052 | **0.02** | ND | ND | **0.02** | **0.03** | **0.01** | **0.49** |
| Lead | 0.015 | **0.3** | **0.37** | **0.17** | **0.23** | **0.98** | **0.11** | NS |
| Sulfate | 250 | **515** | X | X | **1900** | **275** | X | NS |
| Iron | 0.3 | **80.5** | **6** | **152** | **597** | **6.3** | **1.35** | NS |
| Manganese | 0.05 | **6.3** | **0.69** | **2.1** | **26.8** | **.30** | **1.02** | NS |
| Mercury | 0.002 | X | **0.0046** | X | X | **0.007** | **0.005** | NS |
| Nitrate as N | 10 | NS | NS | NS | NS | NS | NS | NS |
| Selenium | 0.5 | ND | ND | **5.56** | ND | ND | X | NS |

Notes:

ND = non-detect; samples are below laboratory detection limits.

NS = not sampled.

X Indicates that sample is below primary and secondary drinking water standards.

**Bold font** indicates a constituent that exceeds primary and secondary drinking water standards in the shallow bedrock groundwater.

Laboratory analysis was not done for any shallow groundwater samples from DMW wells.

[a] Primary and secondary drinking water standards established by the South Carolina Department of Health and Environmental Control; all units are in mg/L.

[b] Wells DMW-08 and DMW-10 were sampled only in the field for electrical conductivity, water level, dissolved oxygen, pH, temperature and cyanide; cyanide-WAD was ND for both wells, no other constituents were sampled.

[c] Cyanide-WAD (weak acid dissociable cyanide) refers to those cyanide species measured by specific analytical techniques.

Source: Schlumberger Water Services 2010a.

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# 3.4 Surface Water Hydrology and Water Quality

Project-related impacts on surface water hydrology and water quality may occur during the entire life cycle of the mining process, including the post-closure phase. Impacts may occur as a result of land disturbance activities, groundwater lowering, channel modifications and rerouting, effluent discharge from the water treatment plant, management of overburden and tailings materials, and changes in water chemistry due to operations.

Project-related impacts on surface water hydrology and water quality could result from watershed alterations, additional loading of nutrients or contaminants, water withdrawals and discharges, stormwater runoff, alteration of groundwater contributions, and clearing and industrial activity. These impacts are discussed in Section 4.4.

The study area for surface water hydrology and water quality includes streams within the Project boundary, along with Buffalo Creek, the Little Lynches River, the Unnamed Tributary to the Little Lynches River southeast of the Project site, and Camp Branch Creek in its entirety. Figure 3.4-1 illustrates the study area for surface water hydrology and water quality, including the streams and associated subwatersheds.[1] Mining features associated with the proposed Project also are shown on the map for context. These features are described in greater detail in Section 4.4.

Characteristics of these surface waters are described in Table 3.4-1. The length of SCDNR streams is based on “blue line” maps provided by the SCDNR. The length of jurisdictional streams was determined through a formal delineation approved by the USACE. For a given basin, the length of SCDNR streams may be longer than that of the USACE-designated streams because the USACE designated wetlands and streams separately. Many of the SCDNR streams run through and correspond to USACE jurisdictional wetlands. Note that the USACE designations are based on field assessments and are based on more detailed information than the SCDNR designations, which are often desktop mapping based. SCDNR data also identify the stream type as perennial, intermittent, or ephemeral.[2] Although this information is not necessarily field verified, it is included in Table 3.4-1 to provide context with respect to the hydrology in the study area.

The drainage areas presented in Table 3.4-1 represent the individual subwatershed areas corresponding to the subwatersheds shown in Figure 3.4-1. Cumulative areas may be obtained by summing the areas of upstream subwatersheds. The mean annual flows are based on the cumulative drainage and represent average flow conditions for the segment. For example, the drainage area of the Little Lynches River upstream of the study area is approximately 34 square miles, with an estimated mean average flow of 34.4 cfs. This contributing area and associated flow is included in the flow estimates for the segments of Little Lynches River within and downstream of the study area, even though the area in the table represents only the area within the specific subwatershed.

---

1 A *subwatershed* refers to the area draining to each stream segment.

2 *Perennial streams* are streams that continually flow. *Intermittent streams* typically have flow but may be dry during dry periods. *Ephemeral streams* are typically dry and flow as response to rainfall events, not baseflow.

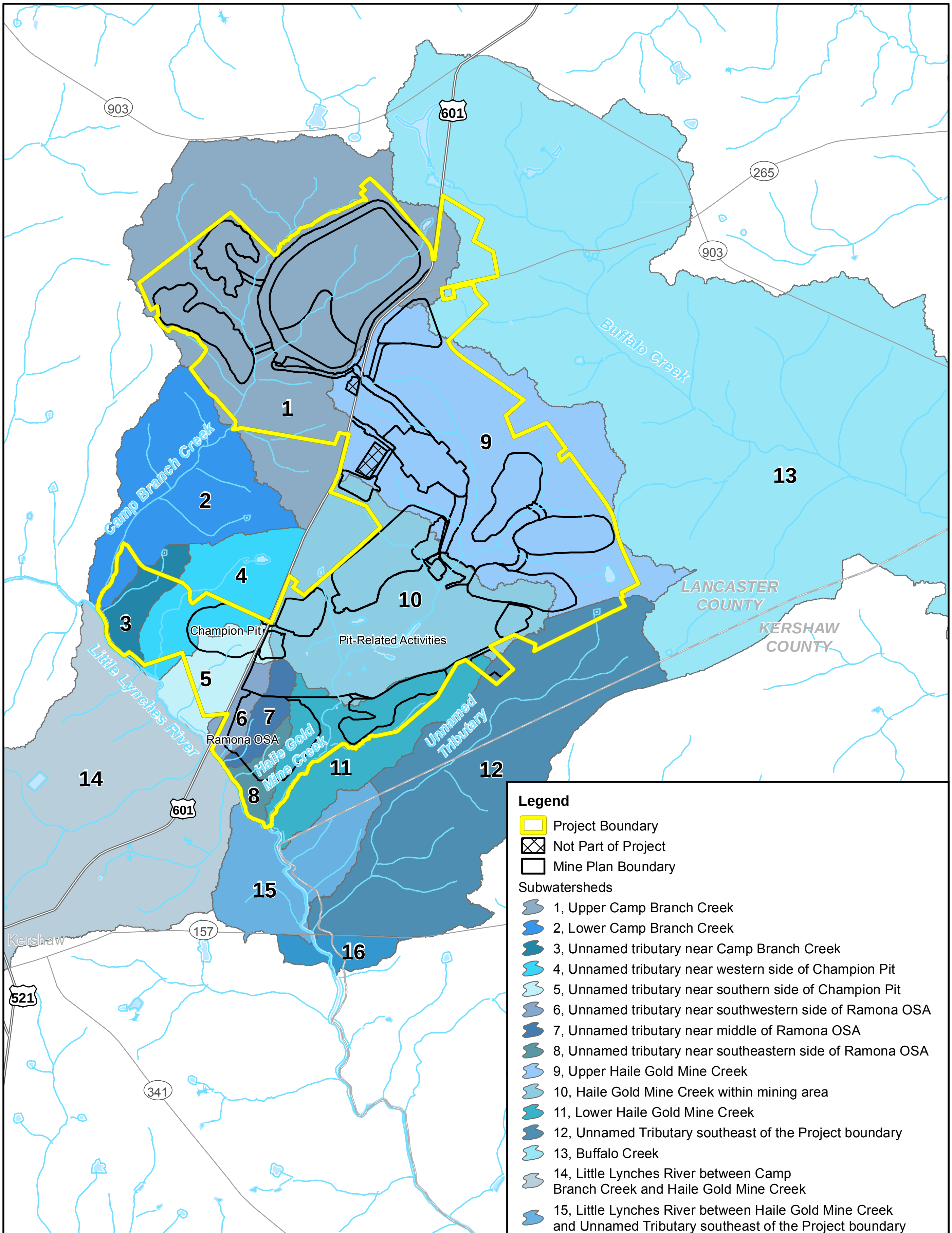


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Figure 3.4-1

**Subwatersheds and Mining Activities in the Study Area**

Source: ESRI 2008.

### Table 3.4-1 Characteristics of Surface Waters and Subwatersheds in the Study Area

| Subwatershed | Individual Subwatershed Area (acres) | Length of SCDNR Stream in Subwatershed (miles) | Length of USACE Jurisdictional Stream in Subwatershed (miles) | Stream Type | Cumulative Mean Annual Streamflow (cfs) |
|---|---|---|---|---|---|
| 1. Upper Camp Branch Creek | 2,074 | 8.13 | 5.93 | Perennial | 3.3 |
| 2. Lower Camp Branch Creek | 659 | 3.66 | 0.50 | Perennial | 4.3 |
| 3. Unnamed tributary near Camp Branch Creek | 122 | 0.65 | 0.42 | Intermittent | 0.3 |
| 4. Unnamed tributary near western side of Champion Pit | 371 | 1.25 | 1.06 | Perennial | 0.6 |
| 5. Unnamed tributary near southern side of Champion Pit | 198 | 0.68 | 0.53 | Intermittent | 0.2 |
| 6. Unnamed tributary near southwestern side of Ramona OSA | 83 | 0.20 | | Intermittent | 0.1 |
| 7. Unnamed tributary near middle of Ramona OSA | 83 | 0.41 | 0.80 | Intermittent | 0.1 |
| 8. Unnamed tributary near southeastern side of Ramona OSA | 77 | 0.45 | | Intermittent | 0.1 |
| 9. Upper Haile Gold Mine Creek | 1,600 | 5.42 | 3.75 | Perennial | 2.5 |
| 10. Haile Gold Mine Creek within mining area | 1,030 | 3.11 | 2.02 | Perennial | 4.2 |
| 11. Lower Haile Gold Mine Creek | 506 | 1.96 | 2.59 | Perennial | 5.0 |
| 12. Unnamed Tributary southeast of the Project boundary | 1,389 | 2.00 | | Perennial | 2.2 |
| 13. Buffalo Creek | 5,978 | 19.22 | | Perennial | 9.5 |
| 14. Little Lynches River between Camp Branch Creek and Haile Gold Mine Creek | 1,658 | 7.62 | | Perennial | 42.8 |
| 15. Little Lynches River between Haile Gold Mine Creek and the Unnamed Tributary southeast of the Project boundary | 410 | 1.94 | | Perennial | 47.8 |
| 16. Little Lynches River downstream of the Unnamed Tributary southeast of the Project boundary | 96 | 0.30 | | Perennial | 50.8 |

Notes:

cfs = cubic feet per second

SCDNR = South Carolina Department of Natural Resources

USACE = U.S. Army Corps of Engineers

The drainage area of the Little Lynches River upstream of Camp Branch Creek is 34 square miles (21,760 acres).

### 3.4.2 Regulatory Setting

The following federal, state, and county regulations govern Project-related activities that could affect surface water hydrology or water quality in the study area. Appendix F contains additional information on regulations that may apply to the Project.

#### 3.4.2.1 Federal Regulations

The following federal laws and programs govern activities associated with surface waters in the Project area:

- **Clean Water Act –** The CWA, originally called the Federal Water Pollution Control Act of 1948, is the primary federal legislation that regulates discharges of pollutants and water quality standards for surface waters of the United States. The CWA (amended in 1972) regulates discharges and activities within surface waters in the Project area. Sections of the CWA relevant to this project are described below:

- **Section 401 –** The USACE grants and administers permits under Section 404 of the CWA. These permits authorize the discharge of dredge or fill into waters of the United States, which include wetlands and navigable waterways. Consultation with the USEPA may be required when applying for a Section 404 permit. Haile Gold Mine currently operates under Section 404 Permit 2004-1G-157, which authorizes placement of fill in a section of old North Fork Creek.

  A federal 404 permit or license for an activity that may result in a discharge to U.S. waters cannot be authorized until a 401 water quality certification has been granted, or waived, by the state or tribe where the discharge would originate. In the State of South Carolina, these certifications are administered by the SCDHEC, as described in Section 3.4.1.2.

- **National Pollutant Discharge Elimination System –** The CWA provides the basis for the NPDES program, which regulates point source pollution discharge from municipal and industrial facilities and municipalities. In South Carolina, these permits are administered by the SCDHEC and subject to the additional state regulations as described in Section 3.4.1.2.
- **Safe Drinking Water Act –** The SDWA is the primary federal legislation that regulates the nation's public drinking water supplies. The USEPA sets drinking water quality standards and oversees the implementation of these standards by states, localities, and water suppliers. In the State of South Carolina, Public Water permits are issued by the SCDHEC, as described Section 3.4.1.2.

- **Clean Air Act –** The federal CAA was passed in 1970 to regulate point source and mobile pollutant emissions into the air.

#### 3.4.2.2 State Regulations

The SCDHEC administers several programs for protection of surface waters that affect activities in the Project area.

- **CWA Section 401 Water Quality Certification –** Pursuant to Section 401 of the CWA, the SCDHEC administers the Water Quality Certification Program which requires a state-issued certification for any activity requiring a Federal 404 permit.
- **South Carolina Pollution Control Act –** The SCPCA (48-1-10) was passed in 1976 and establishes the rules set forth to protect the state's environment, including surface water and groundwater, air, soil, and land (SCDHEC 2012a). The SCPCA includes use classifications for the state's waters,

numeric and narrative criteria, and anti-degradation rules. The requirements described in the SCPCA form the basis for many of the assessment metrics used to quantify the impacts of the proposed Project. The SCPCA applies to perennial, intermittent, and ephemeral streams. If streams are not classified directly by the State, their classification is based on the downstream waters of which they are tributary. The Act requires that the quality of water in tributaries be maintained to protect both the classification of the tributary and its downstream waters.

The SCDHEC assigns classifications of waters as described in Regulation 61-69, which was most recently amended in June 2012. Streams and rivers in the study area are classified as FW (freshwater). As described in Regulation 61-68, freshwaters are suitable for primary and secondary recreation and as a source drinking water supply following conventional treatment. They are also suitable for fishing, survival and propagation of a balanced indigenous aquatic community of fauna and flora, and industrial and agricultural uses.

State waters that do not attain their designated uses are included in the State's Section 303(d) list of impaired waters. Impairment listings and status for streams in the basin are summarized in Section 3.4.2.1.

The SDHEC Bureau of Water administers permits through the Water Facilities Permitting Division. A permit, including plans and specifications, is required prior to construction of a new wastewater treatment facility or modification of an existing wastewater treatment facility. This permitting section of the SCDHEC also administers construction and operating permits related to mining activity.

- **SCDHEC NPDES Effluent Discharge Permits –** The SCDHEC Bureau of Water Regulation 61-9 provides requirements and procedures for NPDES permitting at the state level. This regulation is pursuant to the SCPCA (48-1-10) and was most recently amended in November 2010. The NPDES Wastewater Program regulates wastewater (mine/reclamation effluent or wastewater treatment plant discharge) from point source discharges. Haile Gold Mine currently operates under NPDES Individual Discharge Permit SC0040479 for discharge of treated water from previous mine operations, reclamation areas, and passive treatment cells from Outfall 002 . Haile Gold Mine is finalizing an Effluent Disposal permit application for the wastewater treatment system that would treat excess acid rock drainage that is generated at Johnny's PAG, pit sumps, and the low grade ore stockpile. This discharge would be excess water from the Mill process. The outfall associated with this discharge would be 003; once 003 becomes active, 002 would become inactive. After closure of the Mill, the wastewater treatment system would be modified at the end of active mining to treat cyanide and process chemicals in the residual tailings pool. This treatment would be handled through a modification to the wastewater treatment permit. When flows from the residual tailings pool decreased sufficiently, they would be treated by passive treatment cells that would require construction and discharge or land application permits.

  Regulation 61-9 also covers stormwater discharge. Permitting under this regulation may not be required for discharge from mining activities where stormwater conveyances are not contaminated or have not been in contact with PAG overburden, raw materials, mining products, or associated wastes. Non-contact waters are covered under the general stormwater permit described below.

- **SCDHEC NPDES Construction/Operating Permits –** State law and regulation, through the Water Facilities Permitting Program of the SCDHEC Bureau of Water, require submission of plans and specifications and a written permit before a wastewater system may be constructed or modified. Wastewater systems regulated by the SCDHEC include sewer lines, wastewater pretreatment facilities, wastewater treatment facilities, and sludge handling and treatment facilities. Haile currently operates under two NPDES Wastewater Construction/Operating permits, identified below (Haile

2012a). A separate construction permit would be required to construct the proposed wastewater treatment plant.

Permit 18731-IW was issued for modification of the wastewater treatment system and relocation of outfall 002. The construction permit was issued in July 2002, with the approval to place the modified system in operation in October 2002.

Permit 18873-IW was issued for the passive sulfur reduction bioreactor system. This construction permit was issued in June 2004, with the approval to place the system in operation in May 2005.

- **SCDHEC Air Quality Operating Permits –** The SCDHEC Bureau of Air Quality provides requirements and procedures for permitting at the state level under Regulation 61-62.1. This regulation is pursuant to the SCPCA (48-1-10) and was most recently amended in November 2010. The previous mine site had an air quality permit, but it expired and was not reissued.
- **SCDHEC Air Quality Construction Permits –** Haile was granted a construction permit from the SCDHEC in October 2013 (Construction Permit No. 1460-0070-CA) to construct the Mill. A Title V operating permit would be required within 12 months of completing construction of the facility.
- **South Carolina Stormwater Management and Sediment Reduction Act –** The Stormwater Management and Sediment Reduction Act (48-14-10) was passed in 1991. This Act allows the SCDHEC Bureau of Water to implement standards for managing stormwater runoff and controlling sediment loading to surface waters. These regulations, revised in June 2002, are provided in the *Standards for Stormwater Management and Sediment Reduction* Regulations 72-300 thru 72-316. These regulations detail permit requirements and outline specific design criteria and specifications for stormwater facilities.
- **South Carolina NPDES Stormwater Program –** The NPDES Stormwater Program regulates stormwater point source discharges for municipal separate storm sewer systems, construction activities, and industrial activities.

  Haile Gold Mine currently operates under three NPDES General Permits for Stormwater Discharge Associated with Industrial Activity (SCR004763, SCG730398, and SCG730217) for managing stormwater related to mine operations, reclamation areas, and Hilltop II and Parker Pits.

  On July 2, 2013, Haile submitted an application to the SCDHEC for an NPDES General Permit for Stormwater Discharge Associated with Construction Activity (SCR10S309). This permit addresses stormwater discharge from construction activities at the Mill Site. After construction of the Mill, stormwater would be regulated under SCR004763.

  In July 2005, the SCDHEC published the *BMP Handbook*, a guide for stormwater management and erosion and sediment reduction BMPs (SCDHEC 2005). This guide details procedures to control and limit sediment discharge, in addition to designs for installation and maintenance of various stormwater and erosion control systems.
- **South Carolina Safe Drinking Water Act –** The SCDHEC Bureau of Water issues permits for drinking water supply in accordance with the State's SDWA (44-55-10), under Regulation 61-58 that was amended in August 2009. Haile Gold Mine currently operates under Public Water Permit 2930013 for a well in the Project area that provides drinking water for employees and visitors to the mine.
- **South Carolina Surface Water Withdrawal, Permitting, Use and Reporting Act –** The SCDHEC requires a surface water withdrawal permit for withdrawal of more than 3 mgm or more in any month from surface waters of South Carolina, unless exempted by state law. The diversion of Haile Gold Mine Creek would require a Surface Water Withdrawal Permit to fill Ledbetter Reservoir.

- **South Carolina Dams and Reservoirs Safety Act –** South Carolina state law and regulation require submission of plans and specifications, and a written permit before a dam regulated under this program may be built, altered, or removed. Dams that are 25 feet or more in height or impound 50 acre-feet or more are regulated by the SCDHEC unless exempted by state law. Haile Gold Mine currently holds a Dam Construction permit (29-007) for the proposed dam at the Duckwood TSF. An Abandonment of a Reservoir permit would be required upon drain-down of the tailings pool at the TSF.

- **South Carolina Mining Act–** In 1974, the SCMA was passed to ensure that all mined lands are returned to a useful purpose and for protection of the people and the environment. State law and regulations outline the application process, how to conduct mine operations, and minimum reclamation standards. Haile Gold Mine currently operates under SCDHEC Mine Operating permit 601 for regulation of current closure and reclamation activities in the Project area. An application to modify the 601 permit to allow additional mining is the subject of this EIS. Haile Gold Mine also holds SCDHEC Mine Operating permits 214 (for regulation of closure and reclamation of Hilltop Pits) and 440 (for regulation of closure and reclamation of Parker Pit).

### 3.4.2.3 State Water Quality Standards

The SCDHEC applies state and federal surface water quality standards for the freshwaters in the study area (streams, lakes, ponds, and proposed pit lakes). "Applicable" water quality standards were obtained from Regulation 61-58 *State Primary Drinking Water Regulation* (SCDHEC 2009), Regulation 61-68 *Water Classifications & Standards* (SCDHEC 2012a), and the primary maximum contaminant levels listed in 40 CFR Part 141. These applicable standards are enforceable by NPDES permits or other regulatory mechanism.

The SCDHEC also considers the secondary drinking water standards described in 40 CFR Part 143 that protect aesthetics, taste, and odor. These are "relevant" standards that may require additional study or analyses if monitoring indicates exceedance in surface waters.

These applicable and relevant standards were used to describe the existing water quality in the study area and to evaluate Project-related impacts on surface waters in the study area (Section 4.4). Parameters with water quality standards include field parameters, nutrient values, and metal concentrations. The water quality standards include primary and secondary drinking water standards, human health consumption standards, criterion continuous concentrations (CCCs) for chronic freshwater aquatic organism exposure, and criterion maximum concentrations (CMCs) for acute freshwater aquatic organism exposure.

### General Water Quality Standards

Table 3.4-3 includes general water quality standards for temperature, DO, pH, and turbidity that are promulgated in Regulation 61-68 (SCDHEC 2012a).

### Table 3.4-3 General Water Quality Standards

| Parameter | SCDHEC Standard |
|---|---|
| Temperature | Discharges should not raise the temperature of the receiving stream by more than 5°F or result in a stream temperature greater than 90°F |
| Dissolved oxygen | Daily average not less than 5.0 mg/L, with a low of 4.0 mg/L |
| pH | Between 6.0 and 8.5 |
| Turbidity | Not to exceed 50 NTUs provided that existing uses are maintained |

mg/L = milligrams per liter

NTU = nephelometric turbidity unit

### Nutrients

Nutrient standards were determined from Regulation 61-58 *State Primary Drinking Water Regulation* (SCDHEC 2009) and Regulation 61-68, *Water Classifications & Standards* (SCDHEC 2012a). The standards for ammonia are pH and temperature dependent. The drinking water standard for nitrate is 10 mg/L and for nitrite is 1 mg/L. Total nitrogen and total phosphorus criteria for streams are narrative standards that prohibit discharge of nutrients to streams and rivers in quantities that would cause nuisance microscopic or macroscopic vegetation. Total nitrogen and total phosphorus criteria for lakes in the Piedmont and Southeastern Plains ecoregions are 1.5 mg/L and 0.06 mg/L, respectively. Chlorophyll *a* concentrations in lakes should not exceed 40 µg/L.

### Metals

Elevated trace metal concentrations may adversely affect aquatic life by affecting reproduction, inducing mutations, and causing direct toxicity. South Carolina and the USEPA have established maximum metal concentrations to protect aquatic life and drinking water supplies. These levels typically are adjusted based on the hardness of the ambient waters because of the impact of hardness on the bioavailability of the metals. In the absence of hardness data paired with the metals concentrations, a conservative hardness estimate of 25 mg/L as $CaCO_3$ (calcium) was used as specified by the SCDHEC (2012a).

Trace metal standards were determined from Regulation 61-58 *State Primary Drinking Water Regulation* (SCDHEC 2009), Regulation 61-68, *Water Classifications & Standards* (SCDHEC 2012a), the primary and secondary drinking water standards listed in40 CFR Parts 141 and 143, and the USEPA (2009) National Recommended Water Quality Criteria. Table 3.4-4 lists the applicable and relevant water quality standards for metals for human health and aquatic organisms. These standards are applicable or relevant for all flow conditions (e.g., average flow, low flow).

**Table 3.4-4 Water Quality Standards for Metals for Drinking Water and Aquatic Life**

| Parameter | Freshwater Aquatic Life | | Human Health Consumption and Drinking Water | | | |
|---|---|---|---|---|---|---|
| | CMC (µg/L) | CCC (µg/L) | Water and Organisms | Organism Only | Primary MCL (µg/L) | Federal Secondary Drinking Water Standard or Action Level (µg/L) |
| Standard Type | Applicable | | | | | Relevant |
| Aluminum, total | 750 | 87 | | | | 50–200 |
| Antimony, total | | | 5.6 | 640 | 6 | |
| Arsenic, total | 340 | 150 | 10 | 10 | 10 | |
| Arsenic, dissolved | 340 | 150 | | | | |
| Barium, total | | | | | 2,000 | |
| Beryllium, total | | | | | 4 | |
| Cadmium, total | 0.53 | 0.1 | | | 5 | |
| Cadmium, dissolved | 0.53 | 0.097 | | | | |
| Chromium (III), total | 580 | 28 | | | 100 | |
| Hexavalent chromium (IV) | 16 | 11 | | | 100 | |
| Chromium, total | | | | | 100 | |
| Copper, total | 3.8 | 2.9 | 1,300 | | | 1,300 |
| Copper, dissolved | 3.6 | 2.7 | | | | |
| Fluoride | | | | | 4,000 | |
| Iron, total | | | | | | 300 |
| Lead, total | 14 | 0.54 | | | | 15 |
| Lead. Dissolved | 14 | 0.54 | | | | |
| Manganese, total | | | | | | 50 |
| Mercury, total | 1.6 | 0.91 | 0.050 | 0.051 | 2 | |
| Mercury, dissolved | 1.4 | 0.77 | | | | |
| Nickel, total | 150 | 16 | 610 | 4600 | | |
| Nickel, dissolved | 145 | 16 | | | | |
| Selenium, total | | 5 | 170 | 4,200 | 50 | |
| Silver, total | 0.37 | | | | | 100 |
| Thallium, total | | | 0.24 | 0.47 | 2 | |
| Zinc, total | 37 | 37 | 7,400 | 26,000 | | 5,000 |
| Zinc, dissolved | 36 | 36 | | | | |

CCC = criterion continuous concentration, CMC = criterion maximum concentration, MCL = maximum contaminant level

µg/L = microgram(s) per liter

*Aquatic life standard for aluminum is not listed in R61.68. Per the SCDHEC, applicable standards are based on USEPA (2009).

### General Chemistry

There is no state water quality standard for total suspended solids. Standards for cyanide, sulfate, and total dissolved solids (TDS) were determined from Regulation 61-58 *State Primary Drinking Water Regulation* (SCDHEC 2009) and Regulation 61-68 *Water Classifications & Standards* (SCDHEC 2012a). Table 3.4-5 shows these standards.

**Table 3.4-5 Water Quality Standards for General Chemistry Parameters**

| | Freshwater Aquatic Life | | Human Health Consumption and Drinking Water | | | |
|---|---|---|---|---|---|---|
| Parameter | CMC (mg/L) | CCC (mg/L) | Water & Organisms (mg/L) | Organism Only (mg/L) | Primary MCL (mg/L) | Federal Secondary Drinking Water Standard (mg/L) |
| Standard Type | Applicable | | | | | Relevant |
| Cyanide | 0.022 | 0.0052 | 0.14 | 0.14 | 0.2 | |
| Total dissolved solids | | | | | | 500 |
| Sulfate | | | | | | 250 |

CCC = criterion continuous concentration
CMC = criterion maximum concentration
MCL = maximum contaminant level
mg/L = milligram(s) per liter

## 3.4.3 Existing Conditions

The study area lies within the larger Little Lynches River watershed (Figure 3.4-2). This section describes the surface water hydrology and water quality in this larger basin (Section 3.4.2.1) and in the smaller study area (Section 3.4.2.2).

### 3.4.3.1 Little Lynches River Watershed

### Basin Characteristics

The study area is in the Little Lynches River watershed (03040202-02), which is located in Lancaster and Kershaw Counties, South Carolina. This watershed encompasses nearly 127,000 acres in the Piedmont and Sand Hills regions. The watershed contains 257.5 stream miles and 171.9 acres of lakes, all designated by the SCDHEC as freshwater (FW). Land use/land cover classifications (and associated percentage of the watershed) include forested land (54.5 percent), agricultural land (30.0 percent), forested wetland (9.2 percent), urban land (5.1 percent), scrub/shrub land (0.7 percent), barren land (0.2 percent), water (0.2 percent), and nonforested wetland (0.1 percent) (SCDHEC 2007). An impoundment is located in the upper Little Lynches River watershed near the Town of Kershaw. Section 3.1 provides additional information about the physical setting of the Project area, including climate, topography, , surface water groundwater, and land cover.

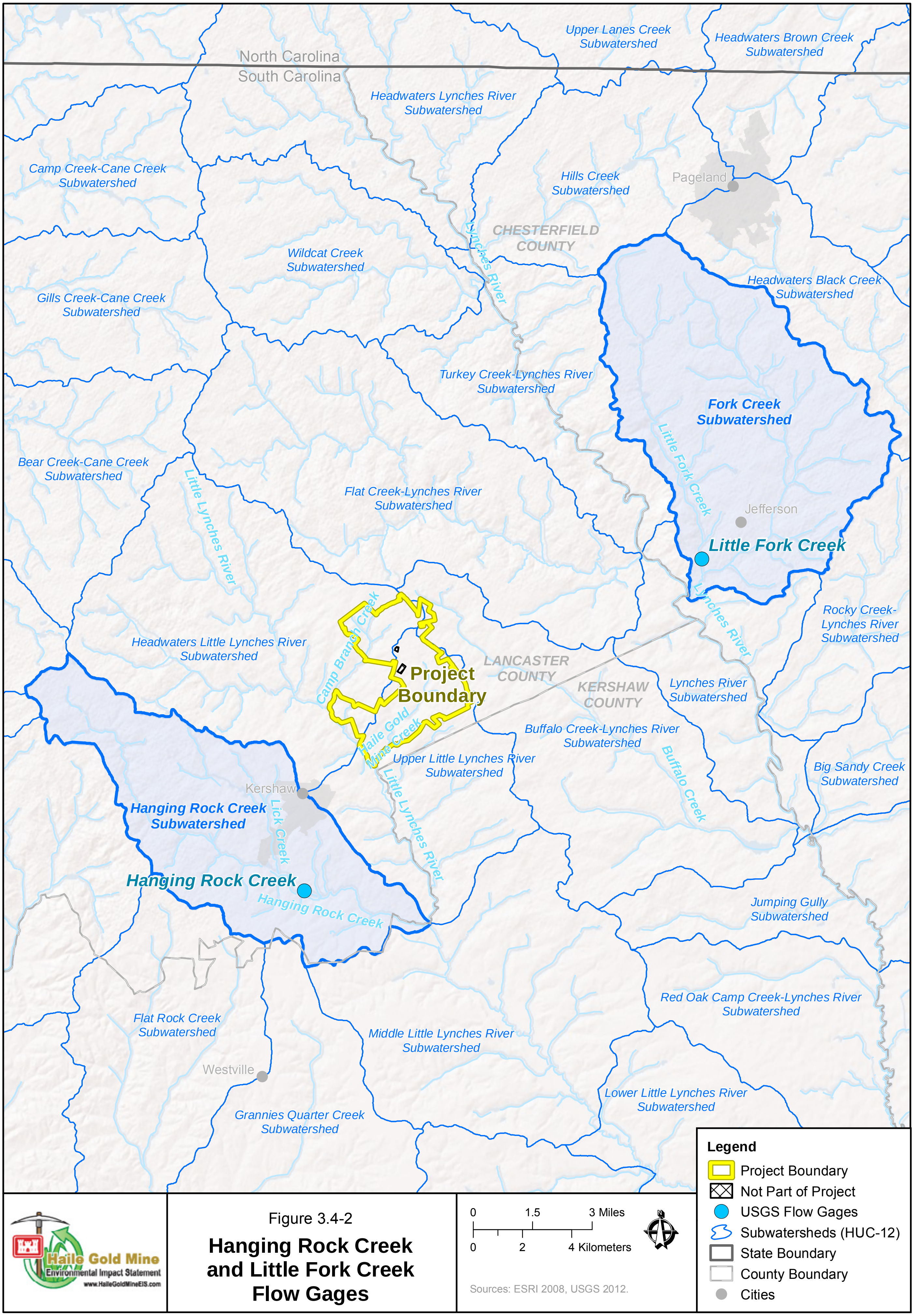


Figure 3.4-2

**Hanging Rock Creek and Little Fork Creek Flow Gages**

## Basin Flow Conditions

The USGS has a historical flow gage in this basin near the Town of Kershaw on Hanging Rock Creek (USGS Gage 02131472) (Figure 3.4-2). The drainage area for the watershed at this gage is 23.9 square miles (15,296 acres), and daily discharge data are available from October 1980 to October 2003. The hydrologic characteristics of Hanging Rock Creek are relatively similar to conditions observed at the Project site (ERC 2012). The highest average monthly flows typically occur in January through March, while the lowest average monthly flows occur from June to September. Overall, the average annual total flow for all months of record was 24.2 cfs, the average annual baseflow was 15.3 cfs, and monthly annual runoff flow was 8.9 cfs.

Appendix J summarizes the results of a baseflow separation analysis developed by Ecological Resource Consultants, Inc. (2012). Over the 23-year period of record for the Hanging Rock Creek gage, runoff flows are generally more variable than baseflows. Although the ranges of flows are fairly similar, with daily runoff flows ranging from 0 to nearly 100 cfs and daily baseflows ranging from 0.5 to nearly 100 cfs, the interquartile[3] range is greater for the runoff flows compared to the baseflows. With respect to season, the baseflow distributions are more variable; lower baseflows occur in summer and higher baseflows occur in winter. For the runoff component, the spectrum of observed flows is similar from month to month. Because total flows primarily comprise baseflows, the distribution of total flow more closely matches that of the baseflow distribution (Appendix J).

## Basin Water Quality

The SCDHEC monitors surface water quality at 14 stations in the Little Lynches River watershed. Aquatic life uses are fully supported at five of these stations. Nine stations are listed as impaired for parameters including copper, fecal coliform, pH, and poor macroinvertebrate scores. Changes in support use status show that water quality at four stations in the basin has improved from 1999 to 2003, while water quality at three stations (all on the Little Lynches River) has degraded. Improving trends at various stations include increased DO and decreased fecal coliform, total phosphorus, and 5-day biological oxygen demand ($BOD_5$). Other trends at various stations include increased turbidity, total nitrogen, pH, and BOD and decreased pH. Tables 3.4-6 through 3.4-9 summarize the listing information (SCDHEC 2007).

**Table 3.4-6 Fully Supported Sites in the Little Lynches River Basin**

| Watershed | Waterbody Name | Station # | Improving Trends | Other Trends |
|---|---|---|---|---|
| 03040202-02 | Little Lynches River | PD-109 | Increasing dissolved oxygen; decreasing fecal coliform | Increasing turbidity, total nitrogen |
| | | PD-343 | Decreasing total phosphorus, fecal coliform | Increasing total nitrogen |
| | Haile Gold Mine Creek | PD-334 | Decreasing biological oxygen $demand_5$, total phosphorus | Increasing pH |
| | Cow Branch | PD-704[a] | | |
| | Beaver Dam Creek | PD-678[a] | | |

[a] Station not evaluated for recreational support.

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3 The *interquartile* refers to the middle half of the data set from the 25th to the 75th percentile.

## Table 3.4-7 Impaired Sites in the Little Lynches River Basin

| Watershed | Waterbody Name | Station # | Use | Status | Water Quality Indicator | Improving Trends | Other Trends |
|---|---|---|---|---|---|---|---|
| 03040202-02 | Little Lynches River | PD-640[a] | AL | PS | Macroinvertebrates | Decreasing total phosphorus | Increasing BOD$_5$ |
| | | PD-006 | AL | NS | Copper | | |
| | | | REC | NS | Fecal coliform | | |
| | | PD-632[a] | AL | PS | Macroinvertebrates | | |
| | Little Lynches River | PD-344 | AL | NS | pH | Increasing dissolved oxygen | Increasing total nitrogen; decreasing pH |
| | Horton Creek | PD-335 | REC | PS | Fecal coliform | | Increasing BOD$_5$ |
| | Todds Branch | PD-005 | REC | NS | Fecal coliform | | Increasing BOD$_5$, turbidity |
| | Lick Creek | PD-329$_{TD}$ | REC | PS | Fecal coliform | Decreasing fecal coliform | |
| | Hanging Rock Creek | PD-328$_{TD}$ | REC | PS | Fecal coliform | | Increasing BOD$_5$ |
| | | PD-669[a] | AL | PS | Macroinvertebrates | | |

Notes:

AL = aquatic life

BOD = biological oxygen demand

DW = drinking water

NS = nonsupported standards

PS = partially supported standards

REC = recreational

$_{TD}$=TMDL developed

[a] Station not evaluated for recreational support.

### Table 3.4-8 Changes in Use Support Status: Little Lynches River Basin Sites That Improved from 1999 to 2003

| Watershed | Waterbody Name | Station # | Use | Status | | Water Quality Indicator | |
|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2003 | 1999 | 2003 |
| 03040202-02 | Horton Creek | PD-335 | REC | NS | PS | Fecal coliform | Fecal coliform |
| | Little Lynches River | PD-343 | REC | PS | FS | Fecal coliform | |
| | Haile Gold Mine Creek | PD-334 | AL | NS | FS | pH[a] | |
| | Lick Creek | PD-329 | REC | NS | PS | Fecal coliform | Fecal coliform |

Notes:

AL = aquatic life

FS = fully supported standards

NS = nonsupported standards

PS = partially supported standards

REC = recreational

[a] This is a naturally low pH system.

### Table 3.4-9 Changes in Use Support Status: Little Lynches River Basin Sites That Degraded from 1999 to 2003

| Watershed | Waterbody Name | Station # | Use | Status | | Water Quality Indicator | |
|---|---|---|---|---|---|---|---|
| | | | | 1999 | 2003 | 1999 | 2003 |
| 03040202-02 | Little Lynches River | PD-006 | AL | FS | NS | | Copper |
| | | | REC | PS | NS | Fecal coliform | Fecal coliform |
| | | PD-632 | AL | FS | PS | | Macroinvertebrates |
| | | PD-344 | REC | PS | NS | Fecal coliform | Fecal coliform |

Notes:

AL = aquatic life

FS = fully supported standards

NS = nonsupported standards

PS = partially supported standards

REC = recreational

One groundwater well (AMB-037) is within the Middendorf Aquifer. In an SCDHEC ambient groundwater monitoring study for the Pee Dee River basin released in 2003, water quality results for AMB-037 indicated a pH of 5.2 and conductance of 31.2 (Waccamaw Regional Council of Governments 2011). Four active NPDES facilities (minor domestic and minor industrial) are located in the watershed. The receiving waters for two of these facilities is Haile Gold Mine Creek, the other two receiving waters are Beckham Branch Creek and Hanging Rock Creek. The two active landfill facilities include the Town of Heath Springs Composting Facility and the Town of Health Springs C&D Landfill. Bethune Dump is an inactive/closed, municipal landfill facility. Mining activities in the watershed include sand (Parker/Blackwell Pit – Jim Lineberg Grading & Paving), gold ore (Haile Mine – Haile Mining Co., Inc.), and sericite (Hilltop Mine – Mineral Mining Corp.) (SCDHEC 2007).

Stations PD-335 and PD-006 were included on the State's approved 2010 and draft 2012 Section 303(d) lists of impaired waterbodies because of excessive levels of fecal coliform (Altman 2012). Total maximum daily loads (TMDLs) for fecal coliform (due to runoff from pastureland) have been developed and approved for Hanging Rock Creek and Lick Creek. To meet the recreational use standard, the needed reductions in current fecal coliform loading from pastureland are 84 percent and 64 percent, respectively (SCDHEC 2007).

The Little Lynches River at US 601 is currently listed as impaired for recreational use due to exceedances of the fecal coliform criteria (SCDHEC 2012b). This segment previously was listed as impaired for aquatic life use because of exceedances of the copper criteria, but this impairment was removed in 2008 for attainment of the copper criteria. Segments of the Little Lynches River upstream and downstream of the segment at US 601 are listed as impaired for aquatic life use due to biologic health (SCDHEC 2012b). Haile Gold Mine Creek was previously listed as impaired for aquatic life use because of low pH levels; this waterbody was removed from the State's 303(d) list of impaired waters in 2004 because, based on an assessment performed by Water Management Consultants (2003), the State deemed the low pH was caused by natural conditions.

### 3.4.3.2 Project Study Area

The study area for this Project includes all waterbodies within the Project boundary and the surface waters that could be indirectly affected by the proposed Project. Figure 3.4-1 shows the subwatersheds in the Project area, and Table 3.4-1 summarizes the drainage area and associated length of stream miles.

#### Study Area Characteristics

Waterbodies affected directly or indirectly by the proposed Project include streams and lakes. Brief descriptions and select photographs of the waterbodies located within the study area are included in this section. Descriptions of the existing passive treatment cells also are included in this section.

##### *Streams and Subwatersheds in the Study Area*

The characteristics of streams and subwatersheds in the study area are similar to those described for the larger Little Lynches River basin. This section describes the characteristics of the streams in the study area.

###### *Camp Branch Creek*

Camp Branch Creek flows in a southwesterly direction and discharges to the Little Lynches River upstream of the current mining footprint. The drainage area of this creek, including the upper and lower subwatersheds, is 2,732 acres. The total length of stream is 11.8 miles, with 6.4 miles designated as jurisdictional streams by the USACE. Much of this area is currently used for timber production. The mouth of Camp Branch Creek at the Little Lynches River is shown in Figure 3.4-3.

Figure 3.4-3 Camp Branch Creek Flowing into the Little Lynches River

## *Haile Gold Mine Creek*

Haile Gold Mine Creek flows in a southwesterly direction toward its confluence with the Little Lynches River and drains 3,131 acres. The creek is perennial and is fed by several smaller perennial and ephemeral streams, including the North Fork of Haile Gold Mine Creek that drains 450 acres. The total length of stream in this subwatershed is 10.5 miles, and 8.4 miles are jurisdictional streams.

Throughout the history of Haile Gold Mine, several major hydromodifications have been made to the watershed. In many locations, Haile Gold Mine Creek has been altered, moved, or channelized. Two reservoirs and numerous ponds associated with mining have been constructed. Ledbetter Reservoir is located along the main reach of the creek, and a small private fishing pond lies along the upper portion of the North Fork. Above Ledbetter Reservoir, Haile Gold Mine Creek and its tributaries are small, blackwater channels (Figure 3.4-4).

Downstream of Ledbetter Reservoir, Haile Gold Mine Creek discharges to the Little Lynches River (Figure 3.4-5). Iron sulfate bacteria are evident from the reddish waters in the channel (Figure 3.4-6).

Figure 3.4-4 Haile Gold Mine Creek near Surface Monitoring Well

Figure 3.4-5 Haile Gold Mine Creek Flowing into the Little Lynches River

Figure 3.4-6 Iron Sulfur Bacteria in Haile Gold Mine Creek

### *Little Lynches River*

The Little Lynches River flows in a southeasterly direction (Figure 3.4-1). It is a perennial river fed by numerous small tributaries, including Camp Branch Creek, Haile Gold Mine Creek, and several unnamed tributaries. Upstream of Camp Branch Creek, the river drains 21,760 acres. At the most downstream section included in the study area for the Project, the drainage area is 32,128 acres.

An old mill dam is located on this river between Camp Branch Creek and Haile Gold Mine Creek (Figure 3.4-7). The trapezoidal weir dam is approximately 20 feet across along the bottom, with an approximately 5-foot drop to the river downstream. Downstream of the dam is a large pool with a sand deposition bar on the left bank facing downstream. Upstream of the dam, water is pooled for approximately 200 feet (Figure 3.4-8). This dam likely provides re-aeration of water (increases DO concentrations) in the Little Lynches River. This structure also affects passage of aquatic organisms.

Based on a site visit conducted on April 10, 2012, the amount of flow observed in the Little Lynches River relative to the amount of flow contributed from tributaries entering the system indicates that much of the flow in the river during dry weather conditions originates from groundwater inputs.

Two large algae blooms were observed in the Little Lynches River during this visit. One was observed upstream of Camp Branch Creek, as shown in Figure 3.4-9. Farther downstream on the Little Lynches River, another very large, filamentous algae bloom was present—approximately 30 feet long, several inches thick, and covering most of the width of the channel (Figure 3.4-10). Algal blooms indicate the presence of relatively high nutrient concentrations and availability of sunlight.

Figure 3.4-7 Old Mill Dam on the Little Lynches River

Figure 3.4-8. Little Lynches River Approximately 200 Feet Upstream of the Old Mill Dam

Figure 3.4-9. Algae Bloom in the Little Lynches River Upstream of Camp Branch Creek

Figure 3.4-10. Algae Bloom in the Little Lynches River Upstream of Old Mill Dam

Downstream of the old mill dam, US 601 crosses the Little Lynches River (Figure 3.4-11). Turbulence in this reach of the river is greater than upstream of the old mill dam, and some deeper water is evident in some areas.

Figure 3.4-11. Little Lynches River at US Highway 601, Facing Downstream

Downstream of where Haile Gold Mine Creek enters the Little Lynches River, the water color becomes reddish and more turbid (Figure 3.4-12).

### *Unnamed Tributaries to Little Lynches River*

Several unnamed tributaries drain to the Little Lynches River within the study area (Figure 3.4-1). The drainage areas of these subwatersheds range from 74 to 1,389 acres, and the length of stream change ranges from 0.2 to 2.0 miles. Most of the lands within these areas are forested and used for timber harvesting. Past mining activities associated with Champion Pit also affect two of the unnamed tributaries. Based on satellite imagery, there appears to be a confined animal operation in the Unnamed Tributary southeast of the Project boundary.

### *Buffalo Creek*

Buffalo Creek is situated northeast of the Project area and generally drains in a southeasterly direction (Figure 3.4-1). The study area in this creek drains an area of 5,977 acres with a total stream length of 19.2 miles.

Figure 3.4-12. Little Lynches River Downstream of Haile Gold Mine Creek

### *Pit Lakes and Ponds*

Several impoundments are located in and around the Project area, as described below and presented in Figure 3.4-13.

#### *West Champion Pit*

West Champion Pit is located west of US 601, north of the intersection with Haile Gold Mine Road. This pit was mined in 1990–1991, closed in late 1991, and allowed to pond. The pit is approximately 1.0 acre; it has stable water quality and supports fish.

#### *Champion Pit*

Champion Pit is located between West Champion Pit and US 601. Champion Pit was mined in 1989–1990 and closed in 2000. This pond is approximately 3.5 acres. At times water in this pit lake is acidic, and Haile adds lime to correct the pH.

#### *Gault Pit*

Gault Pit is a 2.5-acre pond located east of US 601 and north of Haile Gold Mine Road. Gault Pit was mined in 1991 and reclaimed in 2001. Gault Pit receives stormwater from surrounding areas and may periodically overflow into adjacent woodland areas during large precipitation events.

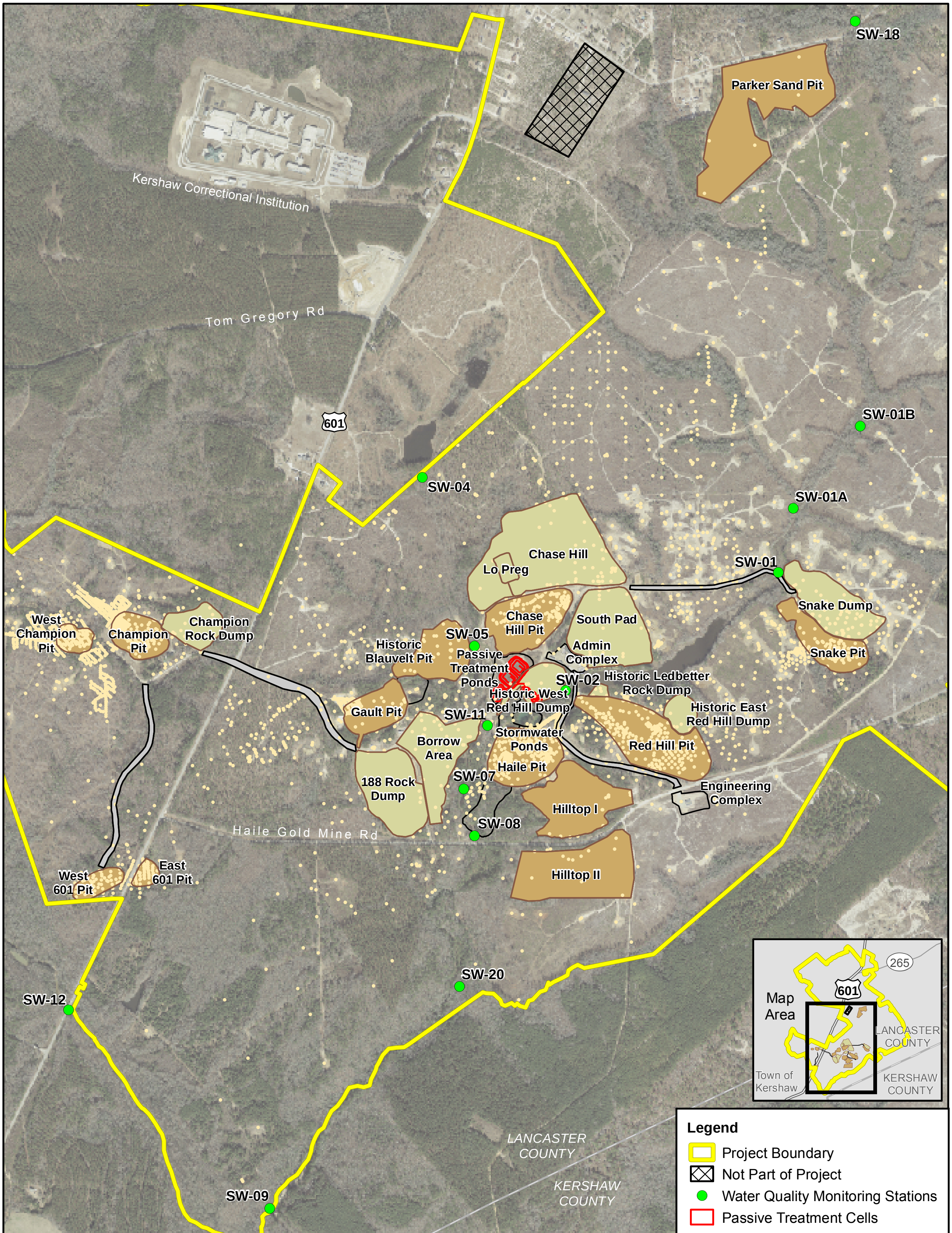



Figure 3.4-13

**Major Features of Prior Mining Activity at the Haile Gold Mine Site**

Sources: ESRI 2008, Lancaster County 2011, Schlumberger 2010.

*Ledbetter Reservoir*

Ledbetter Reservoir is an impoundment of Haile Gold Mine Creek in the central portion of the Project area, just north of Haile Gold Mine Road (Figure 3.4-14). Ledbetter Reservoir is approximately 8.9 acres.

Figure 3.4-14 Ledbetter Reservoir

*Snake Pit*

Snake Pit contains an approximately 2.2-acre pond located west of Ledbetter Reservoir, just north of Gene Lewellen Road. Snake Pit was mined in 1989 and closed as a pond by 2003. Snake Pit receives stormwater flows from adjacent overburden, and flows leave Snake Pit via a spillway into Ledbetter Reservoir.

*Ponds along North Fork of Haile Gold Mine Creek*

Three ponds are along or adjacent to the North Fork of Haile Gold Mine Creek, just west of US 601. The approximate areas of these ponds are1.3, 0.4, and 3.0 acres.

### Passive Treatment System

Haile has constructed a passive treatment system to treat flows from three closed mining facilities: Chase Hill Pit, South Heap Leach Pad (South Pad), and Chase Hill Pad. The passive treatment system consists of buried water collection pipes from each of the three closed areas, a flow distribution vault, two covered sulfate-reducing bio-reactors (SRBRs), an aerobic polishing cell, and an infiltration trench. The two SRBR cells slow the decay of organic matter and allow the byproducts of sulfate-reducing bacterial metabolism to neutralize acidic conditions; provide excess alkalinity; and precipitate insoluble iron, copper, zinc, and cadmium sulfides. The cells store water in a pool that is then gravity-fed through a linear low-density polyethylene (LLDPE) geomembrane. Underneath is an organic substrate composed of chipped wood, manure, agricultural limestone, soybean hulls, and hay/alfalfa (Golder Associates 2004). The estimated lifespan of this mixture is 25–30 years before the substrate is depleted of organic content and would require replacement. The SRBR cells were constructed with covers to limit additional flows from precipitation. The cover includes plastic and LLDPE liners and soils to support plant growth.

Water from the SRBR cells is discharged to the aerobic polishing cells to be re-oxygenated and to remove some dissolved manganese and any remaining dissolved ferrous iron. The aerobic polishing cells discharge from outfall 002 to Haile Gold Mine Creek (SCDHEC 2004).

Figure 3.4-15 shows an aerial view of the passive treatment system.

### Study Area Flow Conditions

#### *Streams*

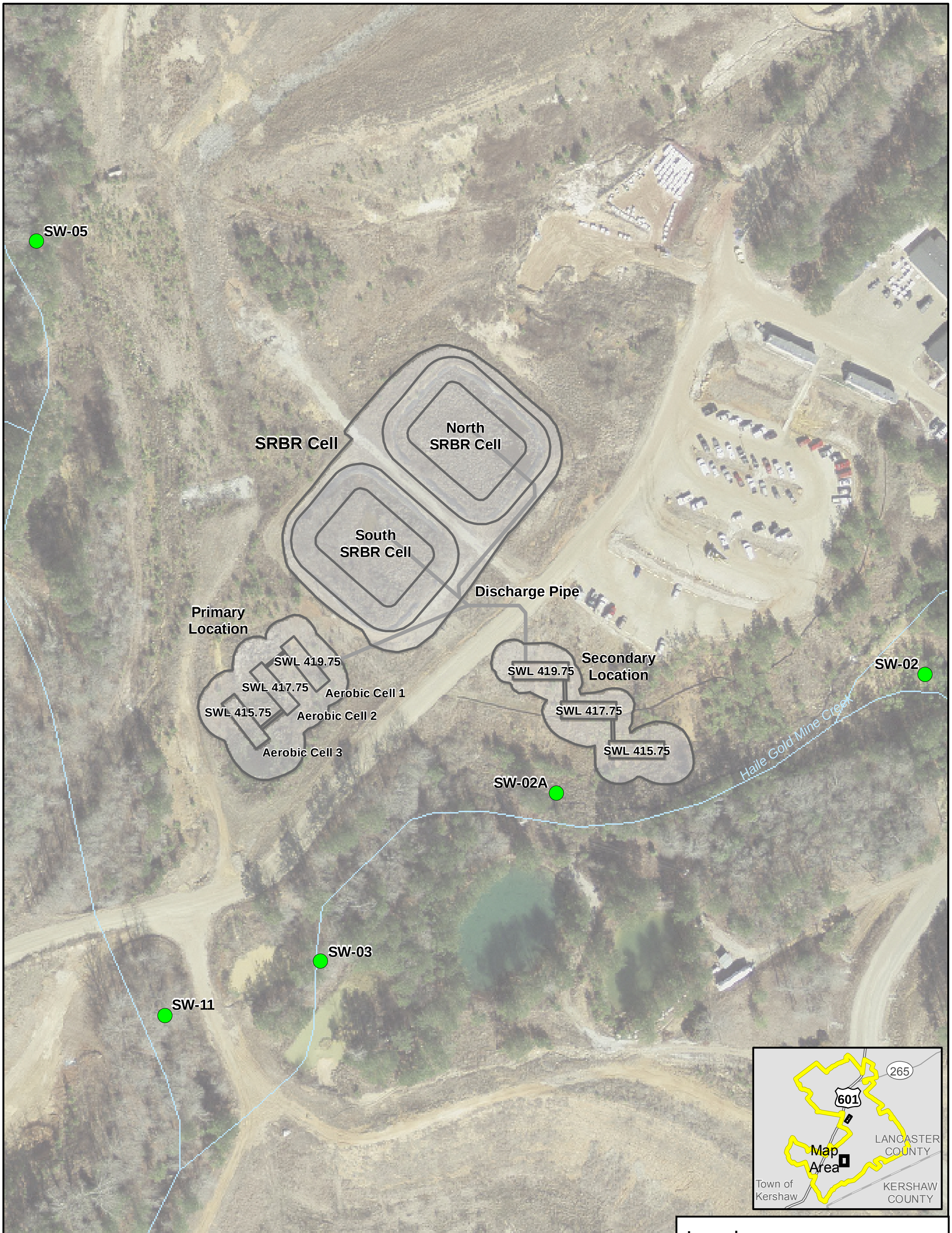
Measurements of instantaneous flow have been measured at streams in the study area from July 1993 to August 2011 at 23 monitoring locations (Figure 3.4-16). The majority of the 600 individual flow measurements were taken during low to average flow conditions, and measurements were not taken less than two days following a storm event for safety reasons. A summary of the data collected at these locations is provided by ERC (2012).

To validate the use of the Hanging Rock Creek gage as an index gage for the study area, ERC used a basin proration method (applying the ratio of drainage areas at the site of interest to the gaged site) to predict daily flows at sites where instantaneous flow measurements were recorded. These daily flow estimates were compared to the instantaneous flow measurements collected in the study area. In general, prorated daily flows at the Hanging Rock Creek gage provide a good predictor of flows in the study area (Haile 2012b).

To describe the current flow conditions for streams in the study area, an analysis of flow data collected at a nearby USGS flow monitoring station on Hanging Rock Creek (USGS Gage 02131472) was used. While this gage is currently inactive, the period of record covers 20 years from 1980 to 2003. Based on these flow data, ERC (2012) developed estimates of daily total flow, baseflow (the contribution from the groundwater), and runoff flows (resulting from precipitation running off of land surfaces). The flows from this gage then were prorated by drainage area to estimate flows for the streams in the study area (see ERC 2012 and Appendix J). Table 3.4-10 presents the average annual total flow, baseflows, and runoff flows for each subwatershed in the study area.

#### *Passive Treatment System*

Flow measurements were recorded from both SRBR outfalls; these flows are relatively minor compared to typical streamflows in the study area. From June 2005 to June 2009, combined flows averaged 5.5 gpm (0.012 cfs). The highest recorded flow was 7.5 gpm (0.017 cfs) in November 2005. From February 2011 to June 2012, lower flows averaging 0.8 gpm (0.001 cfs) were recorded. The passive treatment system was designed to handle approximately 6 gpm (0.013 cfs), with occasional higher flows.

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www.HaileGoldMineEIS.com

Figure 3.4-15

**Passive Treatment System**

Sources: ESRI 2008, Haile 2013, Lancaster County 2011.

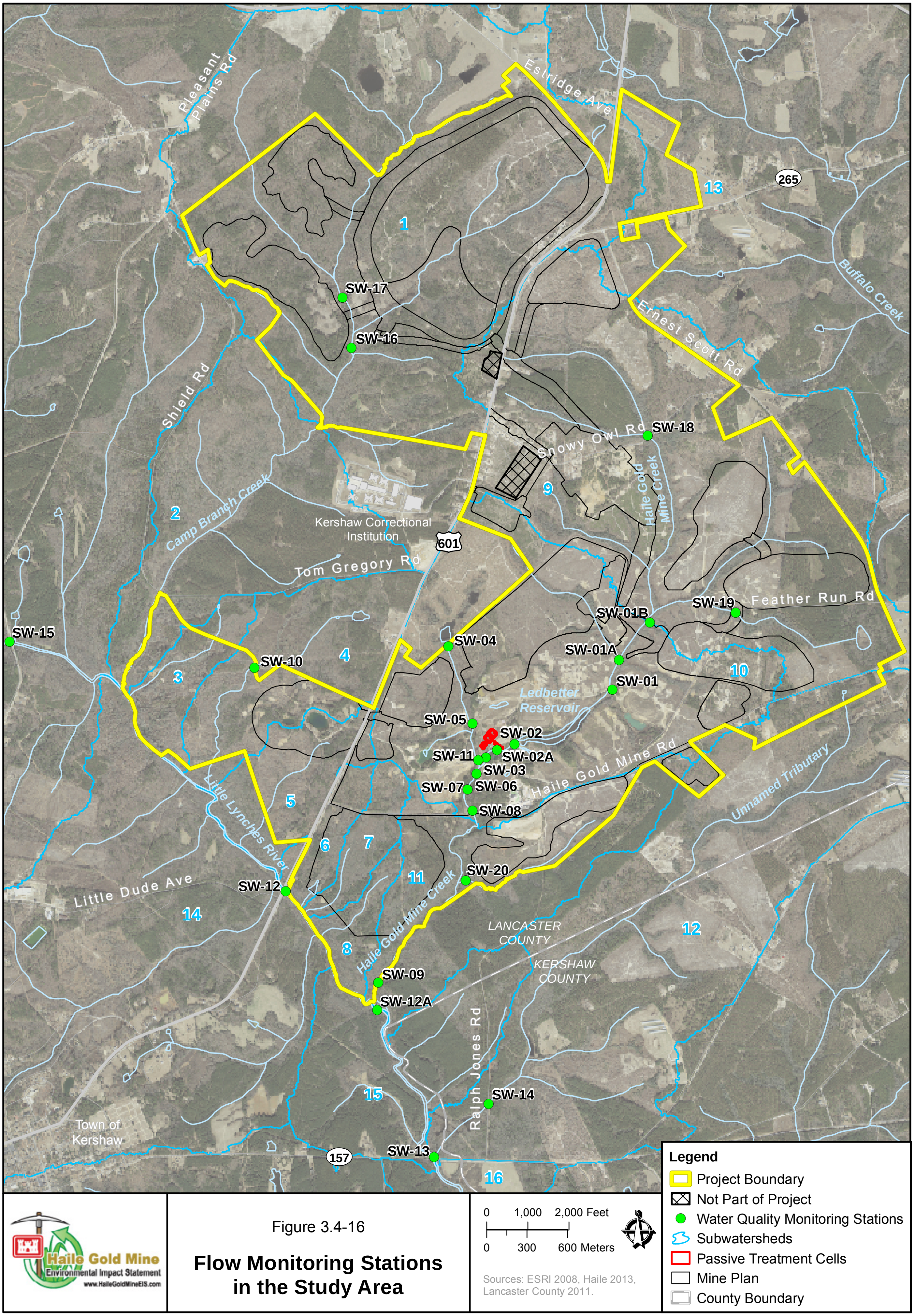


Figure 3.4-16

**Flow Monitoring Stations in the Study Area**

### Table 3.4-10 Annual Average Flow Conditions for Streams in the Study Area

| Stream | Annual Average Total Flow | Annual Average Baseflow | Annual Average Runoff Flow |
|---|---|---|---|
| Upper Camp Branch Creek | 3.2 | 2.0 | 1.2 |
| Lower Camp Branch Creek | 4.4 | 2.8 | 1.6 |
| Unnamed tributary near Camp Branch Creek | 0.18 | 0.11 | 0.07 |
| Unnamed tributary near western side of Champion Pit | 0.4 | 0.18 | 0.22 |
| Unnamed tributary near southern side of Champion Pit | 0.26 | 0.14 | 0.12 |
| Unnamed tributary near southwestern side of Ramona OSA | 0.17 | 0.12 | 0.05 |
| Unnamed tributary near middle of Ramona OSA | 0.15 | 0.10 | 0.05 |
| Unnamed tributary near southeastern side of Ramona OSA | 0.08 | 0.04 | 0.04 |
| Upper Haile Gold Mine Creek | 2.5 | 1.6 | 0.9 |
| Haile Gold Mine Creek within mining area | 4.2 | 2.7 | 1.5 |
| Lower Haile Gold Mine Creek | 5.3 | 3.5 | 1.8 |
| Unnamed Tributary southeast of the Project boundary | 2.4 | 1.6 | 0.8 |
| Buffalo Creek | 11.5 | 8.0 | 3.5 |
| Little Lynches River between Camp Branch Creek and Haile Gold Mine Creek | 42.5 | 26.7 | 15.8 |
| Little Lynches River between Haile Gold Mine Creek and Unnamed Tributary southeast of the Project boundary | 48.7 | 30.8 | 17.9 |
| Little Lynches River downstream of Unnamed Tributary southeast of the Project boundary | 51.5 | 32.7 | 18.8 |

### Study Area Water Quality

Surface water quality samples in the study area have been collected since 1984. The data were compiled for a comprehensive baseline characterization of the Lynches River watershed and, more specifically, to address operations and closure related to previous mining activities. Data collection has focused on field parameters, nutrients, metals, and general chemistry.

In 2008, Romarco initiated a comprehensive baseline monitoring program to better assess current water quality characteristics near the proposed Project site (Schlumberger 2010). Initially, 13 surface water quality monitoring stations were established, and seven stations were added in 2010. Several sampling locations are situated in the Project area on Haile Gold Mine Creek and on North Fork Haile Gold Mine Creek. Downstream sampling locations are located near the confluence of Haile Gold Mine Creek and the Little Lynches River and the Unnamed Tributary southeast of the project boundary (Figure 3.4-17).

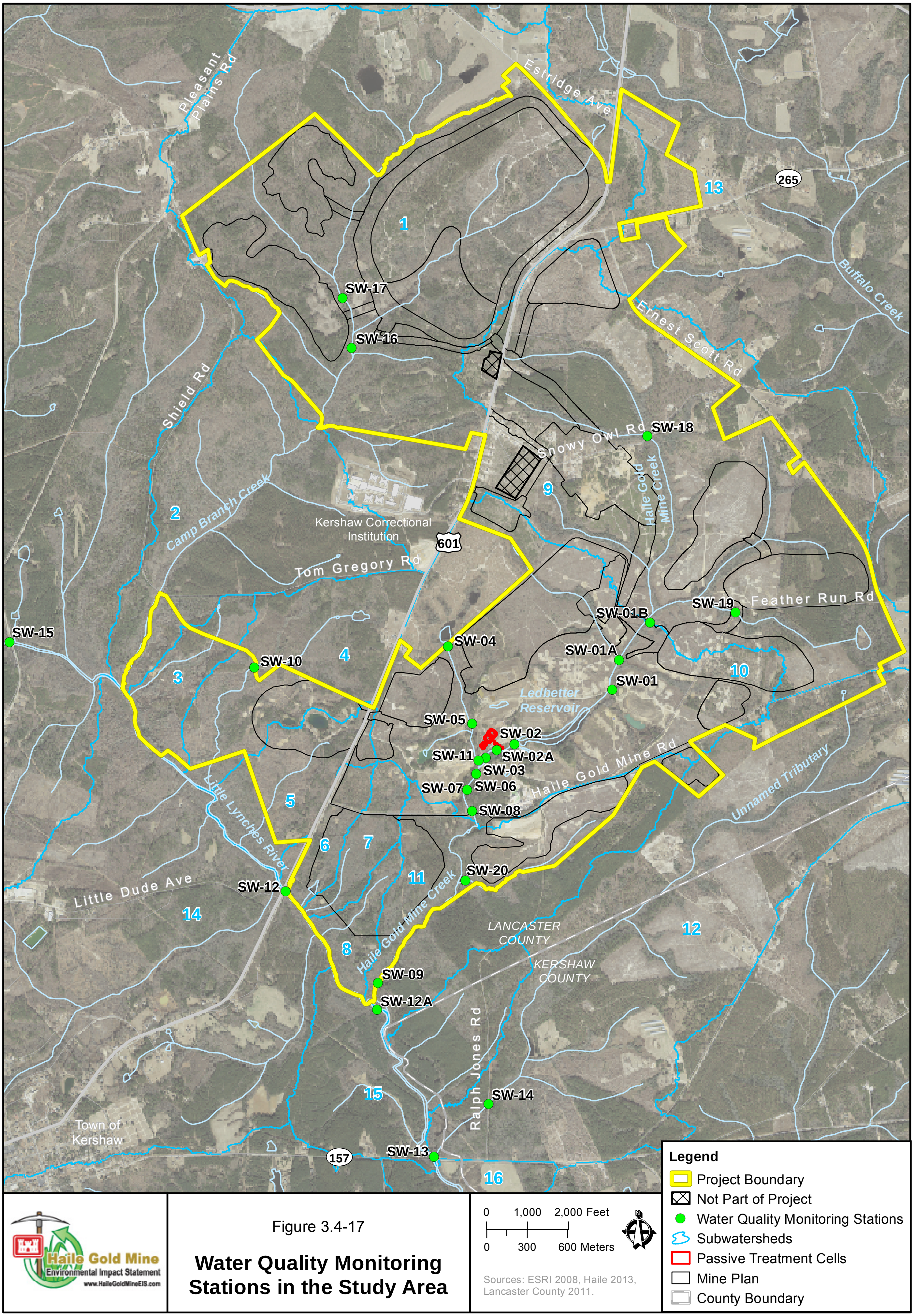


Figure 3.4-17

**Water Quality Monitoring Stations in the Study Area**

### *Streams*

The following descriptions of existing water quality in streams in the study area are based on monitoring data collected by Haile Gold Mine between April 2008 and May 2012. Since 2008, samples were collected at 13 locations to characterize conditions that are reflective of past mining activities, ambient conditions, and areas where potential Project-related impacts could occur. More detailed information regarding the water quality data is provided in Appendix J.

A summary of the data provided by Haile for each class of parameters is listed below. The monitoring results for each parameter are compared to established state water quality standards (Appendix J) for drinking water and aquatic life. For parameters with no established state water quality standards, the monitoring results are compared to sites that were not affected by past mining activities (Camp Branch Creek, the Little Lynches River upstream of Camp Branch Creek, and the Unnamed Tributary southeast of the Project boundary). Conditions at these sites were assumed to represent baseline conditions (the water quality in the stream prior to mining activity).

#### *Field Parameters*

Field parameters measured in the study area include pH, water temperature, DO, and turbidity. Field parameters in the study area do not appear to be affected by historical or current activities at the site. While pH measurements in the study area are often below state water quality standards, low pH has been attributed to natural conditions in the study area. A summary of the field parameter data is provided below; water quality data are summarized by monitoring station in Appendix J.

- SCDHEC **pH** standards for freshwaters are between 6.0 and 8.5. The majority of pH values measured in the Project area, in Camp Branch Creek, and in the Unnamed Tributary southeast of the Project boundary are less than the state standard of 6.0. Values less than 4.0 were observed only in Haile Gold Mine Creek. The pH of the Little Lynches River downstream of the confluence of Haile Gold Mine Creek is slightly lower than those sites upstream of the confluence, reflecting the impact of those lower pH waters in Haile Gold Mine Creek on the larger river. Haile Gold Mine Creek previously was listed as impaired for aquatic life use due to low pH levels. This waterbody was removed from the Section 303(d) list of impaired waters in 2004 because the State deemed the low pH due to natural conditions, based on an assessment performed by Water Management Consultants (2003).
- Many factors can affect surface water **temperatures** in and around a mining site. Changes in depth, flow, shading, and groundwater flows can change the natural ambient temperatures. Unlike many water quality parameters, temperature varies seasonally and diurnally. Although Haile has been collecting temperature data in the streams in the study area since 2009, the data are sparse, and many of the stations have zero or one sample to represent a given month. As expected, monitoring data indicate higher water temperatures in July and August, and lower temperatures in January and December. Water temperatures throughout the study area showed little variability among the monthly average temperatures from site to site. Based on this limited dataset, ambient stream temperatures range from less than 5 °C in winter to up to 30 °C in summer.
- Throughout the study area, **DO** concentrations typically met state standards (minimum instantaneous standard of 4 mg/L and minimum mean daily value of 5 mg/L). The Little Lynches River between Camp Branch Creek and the Unnamed Tributary southeast of the Project boundary had relatively low DO concentrations compared to other streams. In the headwaters of Camp Branch Creek, DO concentrations were typically higher than the minimum standards; no water quality measurements were available for lower Camp Branch Creek because it is outside of the Project boundary. DO

concentrations in lower Haile Gold Mine Creek were generally higher than those observed in the headwaters of Haile Gold Mine Creek.

- **Turbidity** provides a measurement of what is suspended in the water, and the State has established a limit of 50 NTU (nephelometric turbidity units) (SCDHEC 2012a). Little variability in turbidity levels was observed in waters throughout the study area. Median turbidity levels were typically less than 10 NTU. Higher turbidity measurements would be expected during rainfall events.

### *Nutrients*

Nutrient data collected in the study area include ammonia, nitrate, total Kjeldahl nitrogen (used to calculate organic nitrogen), orthophosphate, and total phosphorus. Nutrient concentrations in the study area do not appear to be significantly affected by historical or current activities at the site. A summary of the nutrient data is provided below; water quality data are summarized by monitoring station in Appendix J:

- The **ammonia** concentrations in upper Haile Gold Mine Creek, the Unnamed Tributary southeast of the Project boundary, and the most downstream location on the Little Lynches River were similar to the those at the baseline stations. Higher concentrations were observed within the operational area of Haile Gold Mine Creek and the Little Lynches River downstream of Haile Gold Mine Creek.
- Little variability was observed in **nitrate** concentrations. Like ammonia, higher nitrate concentrations were recorded at the upstream Little Lynches River location relative to the other two background stations located on Camp Branch Creek. The highest median and overall nitrate concentrations in the study area were observed in the Unnamed Tributary southeast of the Project boundary. Based on satellite imagery, there appears to be a confined animal operation in the Unnamed Tributary southeast of the Project boundary. In Haile Gold Mine Creek, values were similar across all sites, except for higher values recorded upstream of historical mining activities. The Little Lynches River between Camp Branch Creek and the most downstream station and the most downstream station had similar nitrate concentrations to each other, and both were lower than the drinking water standard (10 mg/L).
- **Organic nitrogen** concentrations followed similar trends as ammonia and nitrate, with typically higher concentrations in the upstream waters of the Little Lynches River relative to the stations downstream of the Project area. Organic nitrogen values fluctuated in Haile Gold Mine Creek: some stations showed patterns similar to the baseline stations, and others had relatively high concentrations. Values in the Unnamed Tributary southeast of the Project boundary were similar to those for the Little Lynches River, and the highest concentrations were observed at the most downstream station on the Little Lynches River.
- In Haile Gold Mine Creek, higher **total nitrogen (TN)** concentrations occurred in the most upstream sites. Measurements in Camp Branch Creek were similar to measurements in Haile Gold Mine Creek within and downstream of the historical mining area. Elevated concentrations were also recorded in the Little Lynches River downstream stations and the Unnamed Tributary southeast of the Project boundary.
- The measurements of **orthophosphate ($PO_4$) and total phosphorous** were typically below the minimum reporting limits at all sampled sites. Within and directly downstream of the operational areas of Haile Gold Mine, total phosphorous concentration were typically lower than the baseline stations.

### *Metals*

Past mining activities appear to have affected some metals concentrations in the study area. Dissolved aluminum, total copper, total lead, total manganese, total nickel, and dissolved nickel concentrations were generally higher in Haile Gold Mine Creek relative to the other sites in the study area, and observations at the sites historically affected by mining exceeded water quality standards for these parameters. Total iron concentrations throughout the study area, including the baseline stations, typically exceeded water quality standards; the highest total iron concentrations were observed downstream of the discharge from the active passive treatment cells. Water quality concentrations for total arsenic and dissolved arsenic were typically higher in Haile Gold Mine Creek within the historical mining area and lower Haile Gold Mine Creek—although water quality standards for these parameters were not exceeded. Concentrations for these parameters also were relatively high at the Unnamed Tributary southeast of the Project boundary and the Little Lynches River downstream of this Unnamed Tributary. A summary of the metals data is provided below; water quality data are summarized by monitoring station in Appendix J.

- **Dissolved aluminum** concentrations often exceeded the federal secondary drinking water standards for the total fraction (50 µg/L to 200 µg/L) and the chronic aquatic life standard (87 µg/L) throughout the study area. Exceedances of the secondary drinking water standards and the chronic aquatic life standard (87 µg/L) also occurred at the baseline stations. The highest concentrations were observed in lower Haile Gold Mine Creek where approximately ten percent of samples exceed the acute aquatic life standard (750 µg/L).
- All observations of **total antimony** were below the minimum reporting limit, which is below the applicable water quality standards at all sampled sites. No freshwater aquatic life standards are listed for total antimony.
- The majority of the **dissolved and total arsenic** observations were below the minimum reporting limit at all sampled sites. Some concentrations of dissolved and total arsenic observed in Haile Gold Mine Creek within the historical mining area, lower Haile Gold Mine Creek, the Unnamed Tributary southeast of the Project boundary, and the Little Lynches River downstream of this Unnamed Tributary were greater than the minimum reporting limit, but none were greater than applicable water quality standards.
- All **total barium** samples collected were below the drinking water quality standard (2,000 µg/L). No freshwater aquatic life standards are listed for total barium. Observed concentrations were similar at the baseline sites and other sites in the study area.
- All **total beryllium** samples collected were below the minimum reporting limit, which is below the primary drinking water quality standard (4 µg/L). No freshwater aquatic life standards are listed for total beryllium.
- All of the **total cadmium** samples were below the minimum reporting limit and below the primary drinking water quality standard (5µg/L) and the acute freshwater aquatic life standard (0.53 µg/L). However, the minimum reporting limit (0.5 µg/L) is above the chronic freshwater aquatic life standard (0.1 µg/L).
- All **dissolved cadmium** samples at all sites were below the minimum reporting limit and below the drinking water quality standard (5µg/L) and the acute freshwater aquatic life standard (0.53 µg/L). However, the minimum reporting limit (0.5 µg/L) is above the chronic freshwater aquatic life standard (0.097 µg/L).
- **Total chromium (III)** concentrations at all sampling sites were below the minimum reporting limit, the drinking water quality standards (100 µg/L), and the freshwater aquatic life standards. The total chromium (III) samples were collected only in 2012.

- **Hexavalent chromium (chromium IV)** concentrations also were monitored only in 2012 and are below the minimum reporting limit, which is below the primary drinking water quality standard of 100 μg/L and the freshwater aquatic life standards.
- The majority of **total copper** samples throughout the study area were below the minimum reporting limit, but the minimum reporting limit is higher than the aquatic life standards. For samples above the minimum reporting limit, such as those along Haile Gold Mine Creek, the observed concentrations were higher than the baseline stations and exceeded the freshwater aquatic life standards. None of the copper measurements exceeded the human consumption or secondary drinking water standards.
- Like total copper, the majority of **dissolved copper** samples were below the minimum reporting limit throughout the study area. The highest dissolved copper concentrations were observed along the Little Lynches River downstream of Camp Creek and at the most downstream monitoring station where concentrations exceed the freshwater aquatic life standards.
- **Total fluoride** concentrations were well below minimum reporting limits and the primary drinking water quality standard (4,000 μg/L) for all sampled sites. There are no state freshwater aquatic life standards for fluoride.
- The majority of the **total iron** concentrations collected in the study area exceeded the secondary drinking water quality standard (300 μg/L). There are no state freshwater aquatic life standards for iron. The highest total iron concentrations were observed downstream of the discharge from the active passive treatment cells, and concentrations were generally higher in Haile Gold Mine Creek within the historical mining area and lower Haile Gold Mine Creek relative to other stations in the study area.
- **Total lead** concentrations throughout the study area were generally below the minimum reporting limits. The chronic freshwater aquatic life standard (0.54 μg/L) was exceeded at two sites in Haile Gold Mine Creek, one upstream of historical mining activities but within historic timber harvesting areas, and one downstream of the active passive treatment cells.
- Similar to total lead concentrations, **dissolved lead** was below the minimum reporting limit for the majority of samples at all sites. One sample collected in upper Camp Branch Creek exceeded the chronic freshwater aquatic life standard (0.54 μg/L).
- At several sampling locations throughout the study area, including the baseline stations, **total manganese** concentrations were above the secondary drinking water quality standard of 50 μg/L. Fifty percent of the total manganese concentrations exceed the relevant standard at least 50 percent of the time in upper Camp Branch Creek, lower and middle Haile Gold Mine Creek, and the Little Lynches River. There are no state freshwater aquatic life standards for manganese. The highest concentrations were observed in lower Haile Gold Mine Creek and Haile Gold Mine Creek within the historical mining area, and these concentrations were typically one to two orders of magnitude higher than those observed at other stations in the study area.
- **Total mercury** concentrations for all samples were below the minimum reporting limit, except for a single sample collected in the Unnamed Tributary southeast of the Project boundary. The minimum reporting limit, however, is less than the human health consumption criteria. All samples were below the primary drinking water quality standard (2 μg/L) and the freshwater aquatic life standards.
- **Dissolved mercury** concentrations for all samples were below the minimum reporting limit, the primary drinking water standard for total mercury (2 μg/L), and the freshwater aquatic life standards.
- **Total nickel** concentrations were frequently below the minimum reporting limit. Three sampling locations on lower Haile Gold Mine Creek were the only stations in which all samples were above the minimum reporting limit, and 5 to 10 percent of these samples exceeded the chronic freshwater

aquatic life standard 16 µg/L. Observations did not exceed human health consumption criteria, and there are no drinking water standards for this parameter.

- **Dissolved nickel** concentrations were frequently below the minimum reporting limit. Three sampling locations on lower Haile Gold Mine Creek were the only stations in which the majority of the samples were above the minimum reporting limit. The highest concentrations at these three stations exceeded the chronic freshwater aquatic life standard 16 µg/L.
- **Total selenium** concentrations for all samples were below the minimum reporting limit, except for a single sample in Haile Gold Mine Creek collected downstream of the active passive treatment cells. All samples were below the primary drinking water quality standard (50 µg/L), human health consumption criteria, and the freshwater aquatic life standards.
- **Total silver** concentrations at all sampling stations were below the minimum reporting limit and the secondary drinking water standard. However, the minimum reporting limit is above the acute freshwater aquatic life standard (0.37 µg/L).
- **Total thallium** concentrations for all samples were below the minimum reporting limit and the primary drinking water quality standard (2 µg/L). However, the minimum reporting limit is greater than the human health consumption criteria. There are no freshwater aquatic life standards for this parameter.
- **Total zinc** concentrations at the majority of the sites had some observations that were greater than freshwater aquatic life standards (37 µg/L), but no stations exceeded the standard in more the 25 percent of samples. None of the samples exceeded the secondary drinking water standard (5000 µg/L) or the human health consumption criteria. Concentrations observed in Haile Gold Mine Creek were typically lower than those at the baseline stations, except for one of the stations in upper Haile Gold Mine Creek that is upstream of historical mining activities and within historical silviculture activities.
- **Dissolved zinc** concentrations at the majority of the sites had some observations that were greater than the freshwater aquatic life standards (36 µg/L). The highest concentrations were observed at one of the stations in upper Haile Gold Mine Creek that is upstream of historical mining activities and within historical silviculture activities.

### General Chemistry

Historical mining activities do not appear to have significantly affected the general chemistry in the study area based on the water quality data collected from 2008 to 2012. While TDS concentrations and sulfate concentrations were generally higher in lower Haile Gold Mine Creek relative to the other stations in the study area, all samples were below the water quality standards for both parameters. A summary of the general chemistry data is provided below; water quality data are summarized by monitoring station in Appendix J.

- **Cyanide** historically has been used in the Project area to heap-extract gold from piles of ore. Total cyanide levels were below the minimum reporting limits at all the sampling locations. The minimum reporting limits are well below the applicable water quality standards for cyanide.
- The amount of suspended solids with a diameter greater than 0.45 µm is quantified by the **total suspended solids** (TSS) measurements. Levels of TSS at the upper Camp Branch Creek stations and Haile Gold Mine Creek stations within and downstream of historical mining were higher relative to other sampled sites in the study area.
- The amount of minerals and salts dissolved in water is quantified by the measurement of **total dissolved solids** (TDS). Lower Haile Gold Mine Creek had higher concentrations of TDS relative to the other stations. All samples were below the secondary drinking water quality standard (500 mg/L).

- **Sulfate** concentrations at several locations along Haile Gold Mine Creek were higher than those observed at the baseline stations, but all were below the secondary drinking water quality standard (250 mg/L).

#### *Pit Lakes*

Water quality data from three pit lakes were obtained from a 1988 engineering report by Westinghouse Environmental Engineering (Haile 2012c). Although all three of these pit lakes have been backfilled as part of the past site closure plan, data collected from these pits provide an indication of potential water quality at the proposed pit lakes. Values of pH were generally low (3.5) but within the range of observations collected in Haile Gold Mine Creek. Concentrations of cadmium, copper, iron, lead, mercury, zinc, and TSS were higher in one or more of the pit lakes compared to the concentrations observed by Haile in streams in the study area from 2008 to 2012.

#### *Passive Treatment System*

The SCDHEC provided water quality data from the passive treatment system (SCDHEC 2013).[4] Data were collected for pH; flow; alkalinity; and concentrations of cadmium, copper, and zinc. Summaries of cadmium and copper are not provided here because all reported monthly concentrations were less than 0.005 mg/L and 0.010 mg/L, respectively. Data for pH and the monitored metals are described below.

- pH data were collected from the outfall of each of the two SRBRs and from the aerobic polishing cell (APC) that collects the combined outfall of both SRBRs. pH values are lower in the two SRBR outfalls compared with samples from the APC. pH levels are typically neutral in the both the SRBRs and APCs, but a significant decrease in pH occurred in summer/early fall 2011. Neutral pH was restored by winter 2011.
- Alkalinity (as $CaCO_3$ [mg/L]) measurements from the APC were highest in 2005 and decreased exponentially until January 2008, when measurements became more stable, averaging 390 mg/L until June 2009. Measurements from February 2011 to June 2012 averaged 290 mg/L. No data were provided for the SRBR outfalls.
- Concentrations of zinc (µg/L) in the APC were similar to concentrations observed in the streams in the study area. Concentrations were most variable from July 2006 to February 2008, averaging 62 µg/L, with the highest concentration (390 µg/L) observed in October 2006. From March 2011 to June 2012, the average concentration was approximately 14 µg/L.

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[4] Water quality data for the passive treatment system were collected monthly from June 2005 to June 2009 and from February 2011 to April 2012. Haile provided the data to the SCDHEC in its Mine Annual Reclamation Report. The most recent annual report is dated July 30, 2012; however, data from July 2010 to January 2011 were not included in the July 2012 report.

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# 3.5 Water Supply and Floodplains

This section describes the existing water supply resources and floodplain conditions and management in the study area. The water supply portion of the section focuses on the availability and uses of surface water and groundwater resources for agricultural, domestic, industrial and commercial, and public water supply, with an emphasis on consumptive uses of surface water (there are no known pass-through uses) in the study area. The remainder describes the mapped and regulated floodplains potentially affected by the proposed Haile Gold Mine.

Other portions of this EIS describe water-related resources (Sections 3.3, “Groundwater Hydrology and Water Quality” and 3.4, “Surface Water Hydrology and Water Quality”), physical and biological assemblages of surface waters in the Project area (Sections 3.6, “Wetlands and Other Waters of the United States” and 3.7, “Aquatic Resources”) and the Project-related changes that may occur to those resources (Sections 4.3, “Groundwater Hydrology and Water Quality”; 4.4, “Surface Water Hydrology and Water Quality”; 4.6, “Wetlands and Other Waters of the United States”; and 4.7, “Aquatic Resources”).

Proposed Project operations include lowering the aquifer level by withdrawing groundwater to dewater the mine pits in order to extract gold and silver ore. Water produced from dewatering the mine pits, treated ore processing water, and stormwater would be released to surface waters within the Project boundary. The proposed withdrawal of groundwater, alterations in the watershed that may affect runoff rates and volumes, and releases from regulated stormwater discharges may result in effects on water supplies and flooding in the study area.

The following potential direct and indirect impacts on water supplies and floodplain management are associated with the Project:

- A lowered groundwater table associated with dewatering in the Project area could affect the well yields of surrounding groundwater users;
- Changes in surface water flow could affect the availability of water for downstream surface water users; and
- Changes in surface water flow could affect runoff and high flows, potentially affecting flood elevations in regulated floodplains.

Section 4.5 addresses the Project-related impacts on water supplies and floodplain management that are associated with these concerns.

For this resource area, two study areas have been delineated: a surface water supply and floodplain management study area, and a groundwater supply study area. Two areas were delineated based on the nature of the expected resource impacts. For floodplain impacts, the area immediately downstream of potential runoff and discharges from the Project has the potential to be affected. With groundwater, a five mile radial buffer was used. Multiple GIS and tabular datasets, reports from Haile and their consultants, scientific publications and reports, and personal communications with SCDHEC and SCDNR staff were used to help determine the extent of both study areas. Figure 3.5-1 illustrates the two study areas.

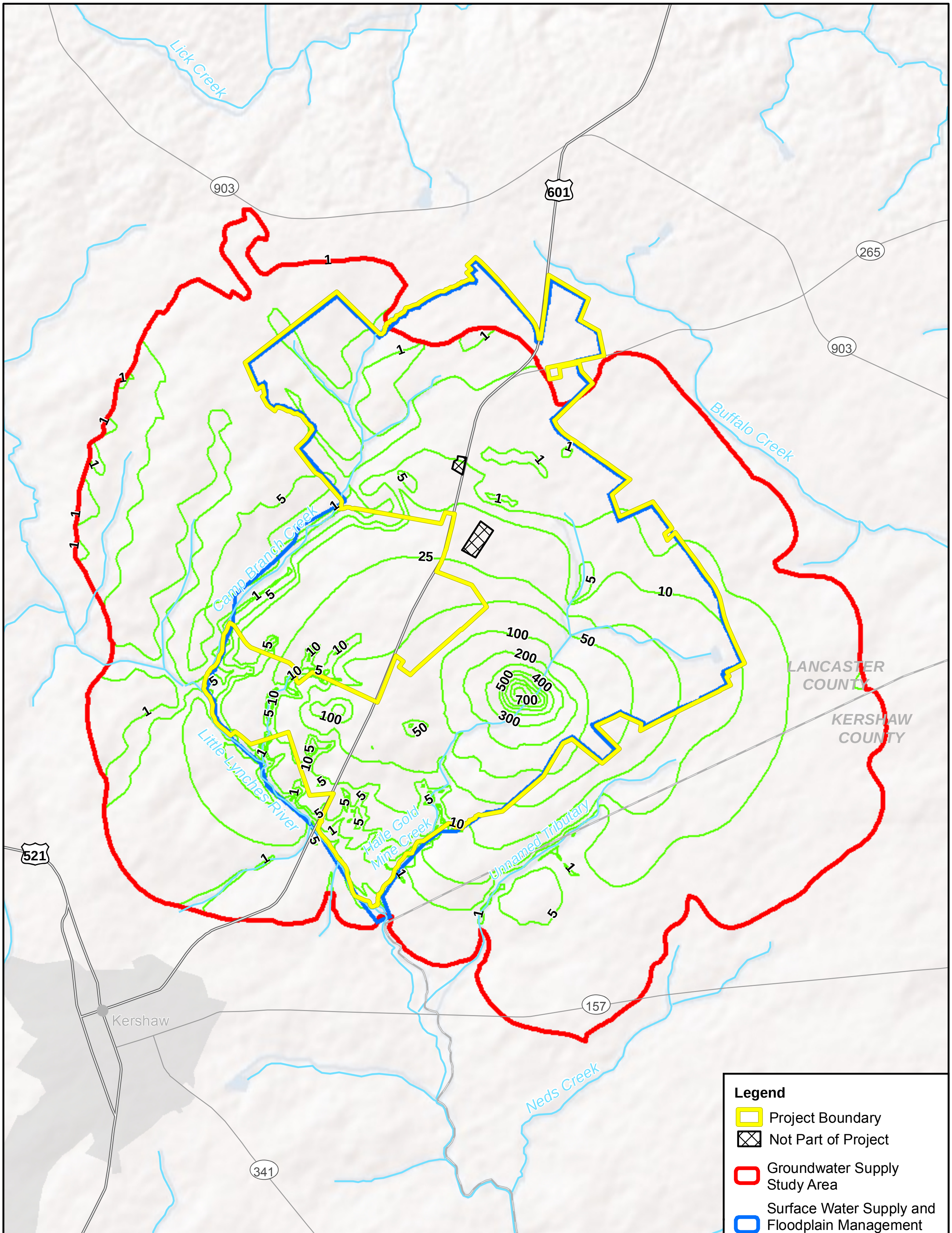


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Figure 3.5-1

**Study Areas for Surface Water Supply and Floodplain Management and for Groundwater Supply**

0 2,000 4,000 Feet

0 500 1,000 Meters

Source: ESRI 2008.

The onsite creeks within the Project boundary and their floodplains, including the portion of the Little Lynches River immediately downstream of the Project boundary, constitute the study area for surface water supply and floodplain management. It is important to note that, although the study area for surface water supply is defined as only the area immediately downstream of the Project boundary, surface water users and withdrawals were tabulated for the entire downstream reach of the Lynches River system. The study area for groundwater supply consists of the three major aquifer units within a 5-mile radius of the Project boundary; a 5-mile radius was chosen to reflect the farthest likely extent of groundwater drawdown impacts (including an added buffer area) based on preliminary groundwater modeling associated with the Project. A buffer was incorporated to ensure that all groundwater users within a reasonable radius of the Project were identified in order to enable adequate quantification of potential Project-related impacts on those users in Chapter 4.

### 3.5.1 Regulatory Setting

The following regulations play an important role in the issues identified above. Appendix F contains additional details on the regulations listed below and other that apply to the proposed Project.

- Federal Clean Water Act
- Section 404 of the Clean Water Act
- State Safe Drinking Water Act
- Mining Act
- Groundwater Use and Reporting Act
- **Surface Water Withdrawal, Permitting, Use and Reporting Act –** In South Carolina, surface water withdrawals greater than 3.0 million gallons per month (mgm) are governed by the 2010 Surface Water Withdrawal, Permitting, Use, and Reporting Act (49-4-10). The Act gives the SCDHEC the authority to permit and regulate surface water withdrawals and to protect minimum flows in state waters (SCDHEC 2011). Water users regulated by the Act must obtain a surface water use permit and periodically report water use to the SCDHEC (SCDHEC 2012a).
- **State Water Well Regulations –** Water well users must obtain a well construction permit and provide notice to the SCDHEC prior to installation, abandonment, or modification of any water well (SCDHEC 2012b). Water well construction and notification requirements are outlined in South Carolina Code of Regulations R.61-44 and R.61-71 (SCDHEC 2012c).
- **National Flood Insurance Act –** The National Flood Insurance Act of 1968 led to creation of the National Flood Insurance Program (NFIP), which allows property owners living in communities participating in the NFIP to purchase flood insurance protection from the government. To participate in the NFIP, communities must adopt and enforce a floodplain management ordinance regulating new construction in Special Flood Hazard Areas designated by the Federal Emergency Management Agency (FEMA). In South Carolina, floodplain requirements are administered by county as described below.
- **Flood Damage Prevention Ordinance of Lancaster County –** FEMA has established minimum floodplain management requirements for communities participating in the NFIP. These communities also must enforce more restrictive state requirements, if applicable, and they are encouraged to adopt regulations that exceed both state and federal requirements.

  In Lancaster County, the appointed Floodplain Administrator oversees and implements the provisions of the Flood Damage Prevention Ordinance. This ordinance is designed to minimize property damage and protect human health and life in areas vulnerable to flooding. The ordinance complies with the

South Carolina Code of Laws, Title 4, Chapters 9 (Article 1), 25, and 27. This local ordinance oversees all development permits where flood hazards exist. Haile has submitted a Project floodplain certification form to Lancaster County. No impacts are expected on floodplains in Kershaw County; therefore, no certification is required from that County.

## 3.5.2 Existing Conditions

### 3.5.2.1 Surface Water Resources and Uses

#### Surface Water Resources

Several streams drain the Project area, including Camp Branch Creek, Haile Gold Mine Creek, and the Little Lynches River (Schlumberger Water Services 2010a). The Project lies within the Little Lynches River watershed, which ultimately contributes to the Lynches River. As noted above, the onsite creeks and their floodplains, including the portion of the Little Lynches River immediately downstream of the Project site, constitute the study area for surface water supply and floodplain management (Figure 3.5.1). Refer to Sections 3.1 and 3.4 of this EIS for additional detail about the surface water resources in the Project vicinity.

#### Surface Water Users

To determine where existing surface water withdrawals might be located in the study area, data regarding withdrawals permitted under the Surface Water Withdrawal, Permitting, Use, and Reporting Act and those in use before implementation of the Act were requested from the SCDHEC (SCDHEC 2012a). The SCDHEC provided GIS data that were used to determine the location and specifications of surface water intakes within and downstream of the Project area.

No permitted surface water withdrawals are known to be located in the study area. It is important to note that the GIS data provided by the SCDHEC represent known surface water withdrawals greater than 3.0 mgm and do not include withdrawals that are below the permit threshold of 3.0 mgm. It is possible (but assumed to be unlikely) that there are withdrawals from the streams and rivers in the study area that are below the permit threshold. This is due to seasonal changes in flow and water quality, in addition to the geomorphology of the river systems in the vicinity of the Project area. Despite the lack of data regarding lower-volume withdrawals, the SCDHEC dataset is the best available source of information on surface water withdrawals.

The SCDHEC data indicate that no agricultural, domestic, industrial, commercial, or institutional surface water withdrawals are known to be located in the surface water supply study area (SCDHEC 2012d, 2012e).

Three intakes were identified more than 100 miles downstream of the Project area but within the greater Pee Dee River watershed on the Waccamaw River, Pee Dee River, and Black Creek—all of these intakes are downstream of, and fed by, the Lynches River (SCDHEC 2012d, 2012e) (Figure 3.5-2). The intakes are owned by Georgetown County, Georgetown Water and Sewer, and the Grand Strand Water and Sewer Authority (SCDHEC 2012d). According to the SCDHEC, each of these withdrawals is currently inactive (SCDHEC 2012e). Based on the distance of these withdrawals to the Project area, the discharge of the Lynches River in the vicinity of these supplies (mean annual flow of 993 cfs), and their inactive status, they were not included in the surface water supply and floodplain management resource study area.

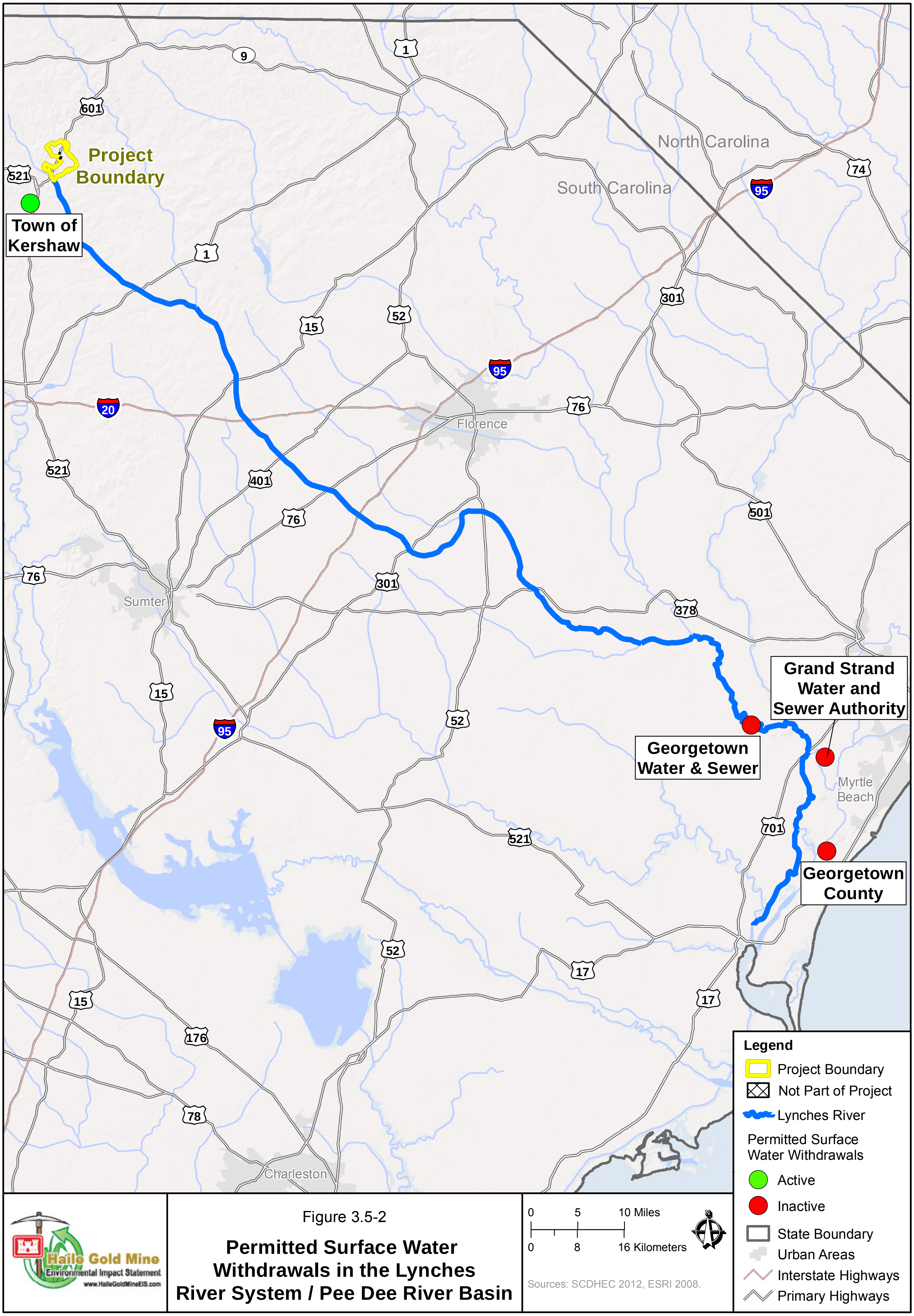


Figure 3.5-2

**Permitted Surface Water Withdrawals in the Lynches River System / Pee Dee River Basin**

The Town of Kershaw has an active surface water withdrawal on Hanging Rock Creek, a tributary to the Little Lynches River (SCDHEC 2012d, 2012e). Because of its location on a tributary to the Little Lynches River (downstream of the Project), this withdrawal also was not included in the surface water supply and floodplain management resource study area.

While there are no known stream or river withdrawals within the vicinity of the Project, ponds and springs in the Project area are used for water supply purposes, mainly at farms. The *Water Resources Inventory: Haile Gold Mine – Wells, Springs, and Ponds* (Kennedy Consulting Services 2013) identified 12 ponds and six springs within 2 miles of the Project boundary that are currently used, or were previously used, for water supply purposes or other beneficial uses. Refer to Figure 3.5-3 for a map of the ponds and springs within 2 miles of the Project.

### Public Water Suppliers in the Vicinity of the Project

Several public water supply utilities provide water service to residents and businesses in the region around the Project area. These utilities include the Town of Kershaw, the Bethune Rural Water District, and the Lancaster County Water and Sewer Department (LCW&SD). Refer to Figure 3.5-4 for a map of the water service areas associated with each of these suppliers. Except for Bethune Rural Water District, these utilities obtain their water from sources outside of the study areas for surface water and groundwater supplies. Additional detail regarding the Bethune Rural Water District's public supply wells is provided in Sections 3.5.2 and 3.5.3. The Town of Kershaw and LCW&SD obtain water from Hanging Rock Creek and the Catawba River, respectively. These public water suppliers may play a significant role in replacing water supplies that are affected by the Project (refer to Section 4.5.1).

## 3.5.2.2 Groundwater Resources and Uses

### Aquifer Systems

Groundwater in the vicinity of the Project occurs within three major hydrogeologic units, each with different characteristics. Table 3.5-1 shows the groundwater use by hydrogeologic unit in the Project area.

The majority of the groundwater withdrawn in the groundwater supply study area is withdrawn from the saprolite and bedrock units (SCDNR 2012a). These units are generally low-yielding within the Project area but are the only source of water supplies to many of the self-supplied water users in the study area. The CPS unit also produces usable quantities of groundwater but is discontinuous within the study area and is generally less than 50 feet thick where present (Schlumberger Water Services 2010b). (Refer to Section 3.2 of this EIS for a full description of the hydrogeology of the Project area.)

### Groundwater Users

Groundwater well data for the study area were acquired from the SCDNR and the SCDHEC. According to both SCDNR and SCDHEC staff, the well locations and data provided likely represent approximately only 50 percent of the wells installed in the area (SCDNR 2012b; SCDHEC 2012f). Many wells were installed before state well permitting regulations were in effect, and sparse records are available even for some wells that are properly permitted. Furthermore, SCDNR staff noted that the coordinates provided for some of the wells in Lancaster County were likely inaccurate (SCDNR 2012b).

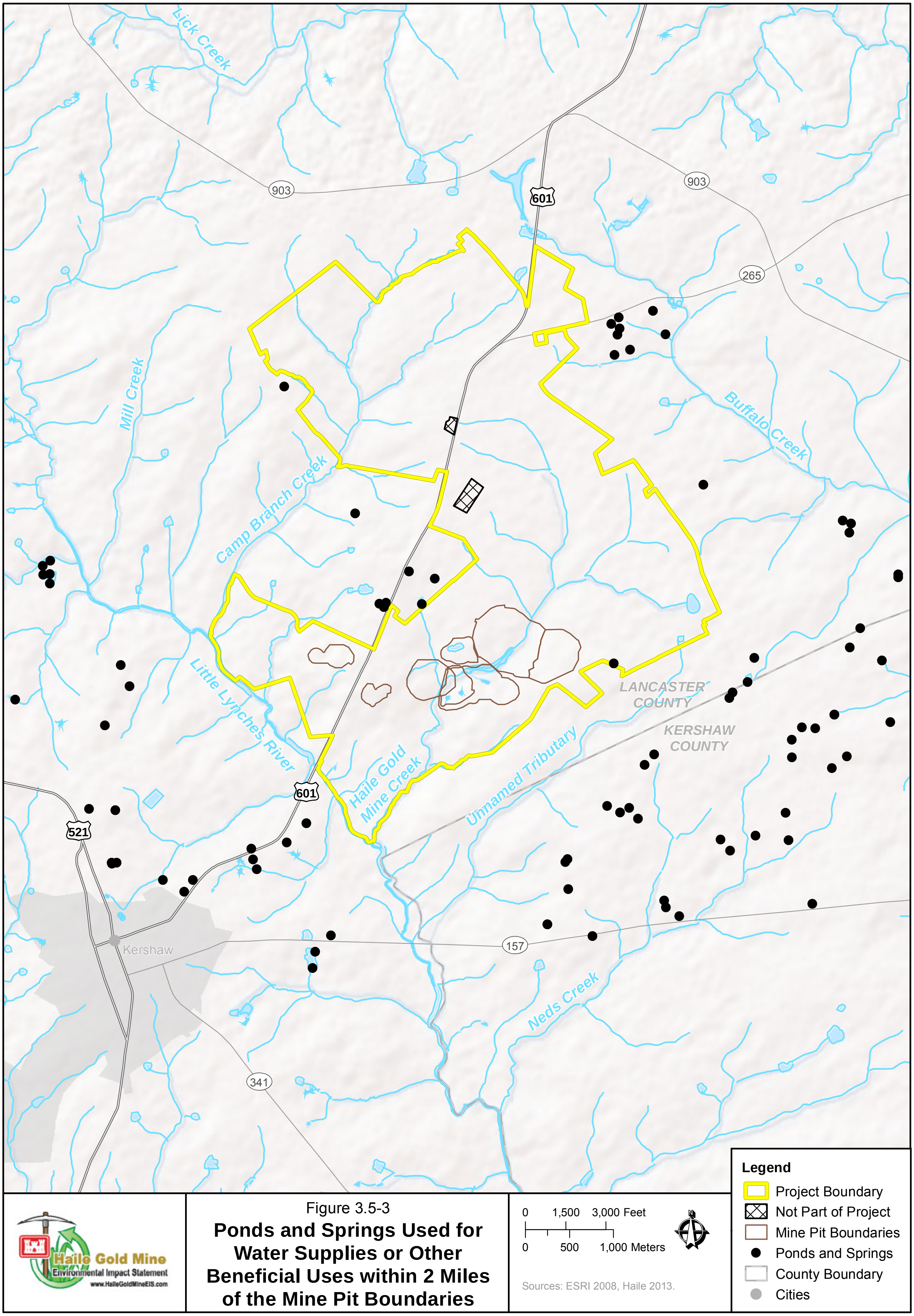


Figure 3.5-3

**Ponds and Springs Used for Water Supplies or Other Beneficial Uses within 2 Miles of the Mine Pit Boundaries**

Sources: ESRI 2008, Haile 2013.

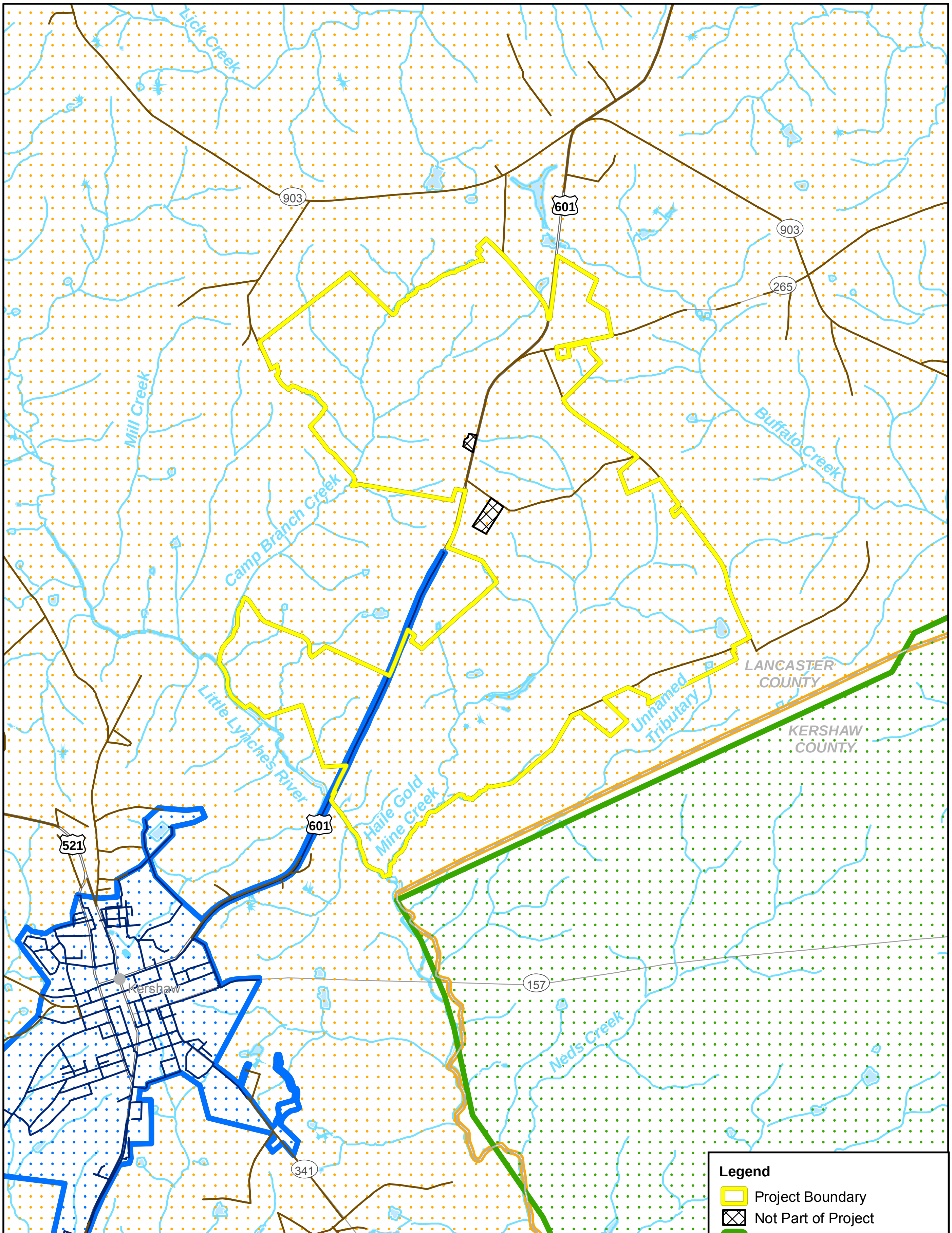


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Figure 3.5-4

**Public Water Supply Service Areas in the Vicinity of the Project**

0 1,500 3,000 Feet
0 500 1,000 Meters

Sources: BRWD 2013, ESRI 2008, Haile 2012, Kershaw 2013, LCW&SD 2013.

### Table 3.5-1 Groundwater Use by Hydrogeologic Unit in the Project Area

| Hydrogeologic Unit | Formation Name | Groundwater Use |
|---|---|---|
| Coastal Plain Sands | Middendorf Formation | This unit is not significant as a groundwater source in the study area but is a significant, high-yielding source of groundwater in the Coastal Plain. Reported well yields in the study area are low (average 8 gpm). This unit also is used to meet some light commercial and domestic needs in Lancaster and Kershaw Counties. Data from the SCDNR well database suggest that less than 15% of the known wells in the study area are completed in this unit. |
| Saprolite and sap-rock | Same as uppermost underlying bedrock | Well yields are variable but may be up to 150 gpm for large-diameter wells in areas of appreciable saprolite thickness. This unit is used to meet domestic water needs within the study area. Data from the SCDNR well database suggest that less than 8% of the known wells in the study area are completed in this unit. |
| Bedrock | Richtex Formation | More than 75% of the water wells in the study area are completed in this unit. Yields are highly variable but are sufficient to meet public water, domestic, and industrial needs in the study area. |
| | Persimmon Fork Formation | |
| | Diabase (volcanic) dikes | |

Notes:

gpm = gallons per minute

SCDNR = South Carolina Department of Natural Resources

*Completed* means that a well has a screened interval or open borehole interval in the hydrogeologic unit indicated. The well is designed to withdraw water from this unit.

Source: SCDNR 2012a.

Additional research and GIS-based geocoding were performed to verify and adjust the locations of the wells based on parcel identification numbers and well owner information. The SCDHEC and SCDNR databases were combined into a GIS dataset of wells within the study area. A total of 180 wells were identified within 5 miles of the Project boundary from the well databases supplied by the SCDNR and the SCDHEC (Figure 3.5-5).

In addition to the well data provided by the agencies, Haile provided a list of 23 former domestic supply wells that currently are used as monitoring wells (Haile 2013). Little data are available about these wells, and basic construction characteristics are not known. The wells are being used by Haile and their consultants to collect water level data in support of groundwater modeling efforts for this EIS. Due to the lack of data, and the fact that these wells already are being used solely by Haile, they are not included in the well inventory presented herein.

Haile, in coordination with the SCDHEC and the USACE, also identified 69 wells within 2 miles of the Project, in the *Water Resources Inventory: Haile Gold Mine – Wells, Springs, and Ponds* (Kennedy Consulting Services 2013). The well locations and specifications identified in the Water Resources Inventory are likely to be more accurate than those identified in the SCDHEC and SCDNR databases, as they were identified through recent field surveys and owner interviews conducted in the Project area.

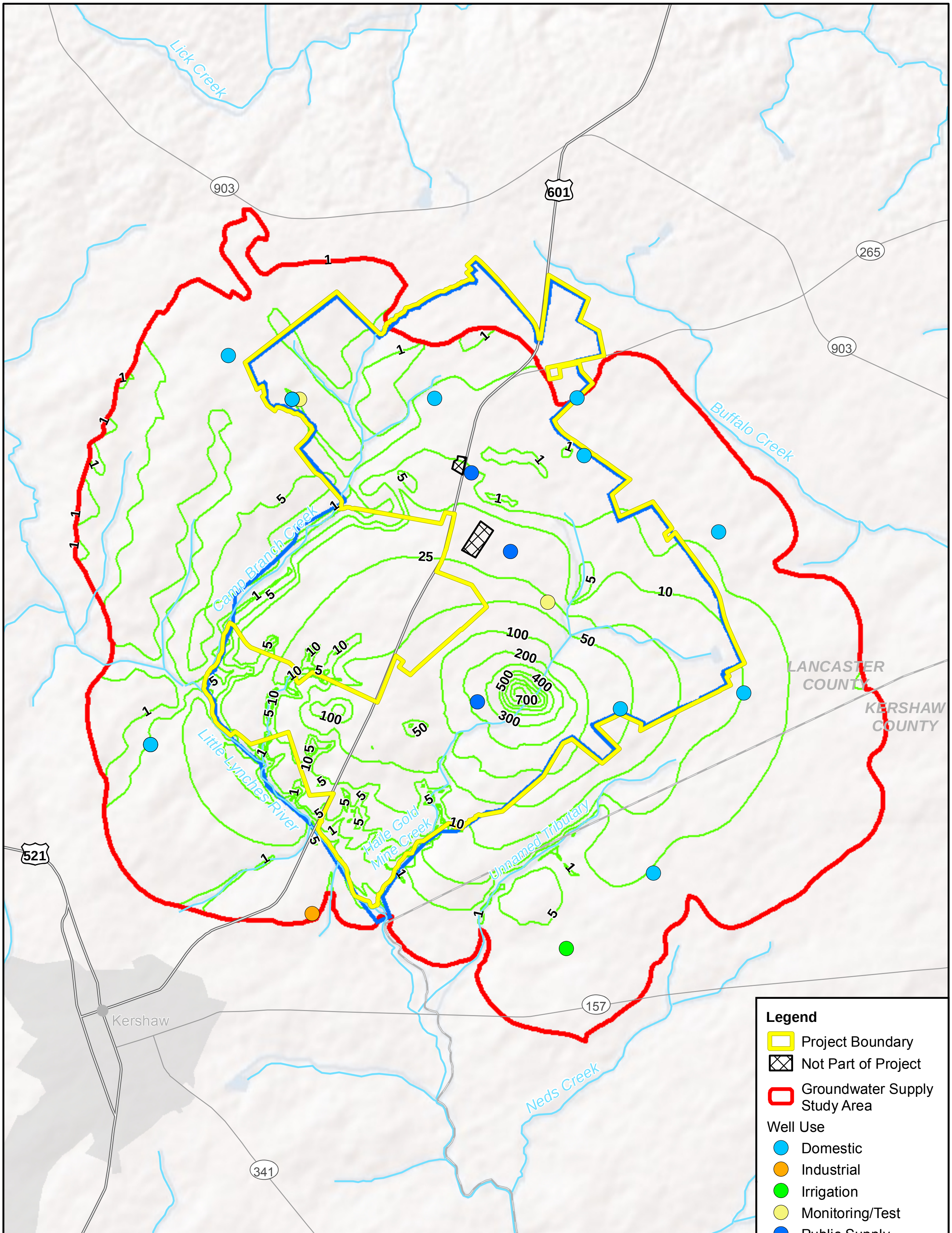


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Figure 3.5-5

**Known Groundwater Wells in the Groundwater Supply Study Area**

Sources: ESRI 2008, SCDNR 2012.

Although records were not available for all wells in the study area, the well records obtained provide a reasonable representation of the well construction characteristics (SCDHEC 2012f) and the distribution of wells within the region (Table 3.5-2). The combined well database constitutes the best available data for use in this EIS.

### Table 3.5-2 Well Characteristics for Known Groundwater Wells in the Study Area

| | Number of Wells by Aquifer System | | | | Number of Wells by Use Type | | | | | Average Well Construction Specifications | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Number of Wells[a] | Coastal Plain Sands | Saprolite | Bedrock | Unknown | Agricultural | Domestic | Industrial, Commercial, and Institutional | Public Water Supply | Other[b] | Total Depth (ft) | Cased Depth (ft) | Diameter (in.) | Pump Depth (ft bls) |
| 237 | 31 | 6 | 3 | 197 | 28 | 157 | 6 | 18 | 28 | 201 | 70 | 6 | 121 |

Notes:

bls = below land surface

[a] Includes all wells obtained from the South Carolina Department of Health and Environmental Control and the South Carolina Department of Natural Resources in the groundwater supply study area, and all wells from the Haile Water Resources Inventory Report by Kennedy Consulting Services (2013).

[b] This category includes monitoring/test wells and wells with unknown uses.

Sources: SCDHEC 2012g, 2012h, 2012i; SCDNR 2012c; Kennedy Consulting Services 2013.

In addition to the well location and construction data provided by the SCDNR and the SCDHEC, the SCDHEC provided 2011 groundwater use data collected as part of the Groundwater Use and Reporting Act. The dataset includes water users in the groundwater supply study area who used 3.0 mgm or more in any month of the year (Table 3.5-3).

### Table 3.5-3 Reported Groundwater Use in the Study Area (2011)

| Permittee[a] | County | Number of Active Wells | Average Monthly Use (million gallons) | Total 2011 Use (million gallons) |
|---|---|---|---|---|
| Town of Bethune Water Treatment Plant | Kershaw | 1 | 0.60 | 14.46 |
| Bethune Rural Water Company | Kershaw | 4 | 1.75 | 84 |

[a] Includes only groundwater users who are regulated under the Groundwater Use and Reporting Act.

Source: SCDHEC 2012i.

Groundwater users in the study area include the following:

- **Agricultural Supply –** There are 28 agricultural irrigation wells known to be in the study area, with an average depth of 171 feet (SCDHEC 2012g, 2012h, 2012i; SCDNR 2012c; Kennedy Consulting Services 2013). None of the known agricultural withdrawals are subject to the reporting requirements pursuant to the Groundwater Use and Reporting Act.
- **Domestic Supply –** There are 157 domestic supply wells known to be in the study area (SCDHEC 2012g, 2012h, 2012i; SCDNR 2012c; Kennedy Consulting Services 2013). The average depth of the domestic wells is 191 feet. Private domestic wells are not subject to the reporting requirements set forth in the Groundwater Use and Reporting Act (SCDHEC 2012b).
- **Industrial, Commercial, and Institutional Supply–** Six industrial wells are known to be in the study area, with an average depth of 349 feet. All of the wells are associated with Springs Cotton Mills; based on their depth, they likely are bedrock wells (SCDHEC 2012g, 2012h, 2012i; SCDNR 2012c). The average production capacity of the wells is 38 gpm. No water use was reported in the year 2011 for Springs Cotton Mills under the Groundwater Use and Reporting Act.
- **Public Supply –** The 18 public water supply wells known to be in the study area have an average depth of 271 feet (SCDHEC 2012g, 2012h, 2012i; SCDNR 2012c). Based on the depth of these wells, they likely are completed in the bedrock aquifer.

  Most of the public supply wells in the study area are subject to the reporting requirements of the Groundwater Use and Reporting Act. Five of the public supply wells appear to be inactive or emergency wells and are owned by the Town of Kershaw, whose principal water source is Hanging Rock Creek in the Pee Dee River Basin (SCDHEC 2003a). The Town of Bethune served 270 people in 2003 via their two public supply wells (SCDHEC 2003b). In addition, the Bethune Rural Water Company served 2,470 people in 2003 via their two public supply wells in the study area (SCDHEC 2003c). Haile Gold Mine, Vincent's Mobile Home Park, Mr. G's-Flat Creek (SCDHEC 2003d), and Mahaffey Mobile Home Park also operate five public water supply wells (Mahaffey Mobile Home Park has two wells) in the study area. Each of these wells serves populations of 26 people or less (SCDHEC 2012d). No water use or service area data were available for the additional four known public supply wells in the study area.

- **Monitoring and Test Wells –**Nine monitoring or test wells are known to be in the study area, with an average depth of 249 feet (SCDHEC 2012g, 2012h, 2012i; SCDNR 2012c). In addition, 28 wells in the study area are of unknown use. None of these wells are subject to the reporting requirements of the Groundwater Use and Reporting Act.

#### 3.5.2.3 Regulated Floodplains and Floodplain Management

Several existing mapped and regulated floodplains associated with the aforementioned streams cross or are adjacent to the Project boundary. Although no mining, earth-moving, or other operations associated with the Project are planned within the regulated floodplain, impacts on the functioning of the floodplain (changes in peak flows and flood elevations) may occur as a result of land disturbance and changes in runoff within the watershed and the planned discharges associated with the Project.

FEMA Digital Flood Insurance Rate Maps (DFIRMs) acquired for the Project areas indicate that the approximately 59 acres of regulated floodplain associated with Haile Gold Mine Creek, the Little Lynches River system, and Camp Branch Creek all overlap or are adjacent to the Project footprint (Figure 3.5-6).As illustrated in Figure 3.5-6, the existing regulated floodplains are 100-year, FEMA Zone "A" floodplains, meaning that there is an estimated 0.1% annual chance of inundation for these areas (FEMA 2013).

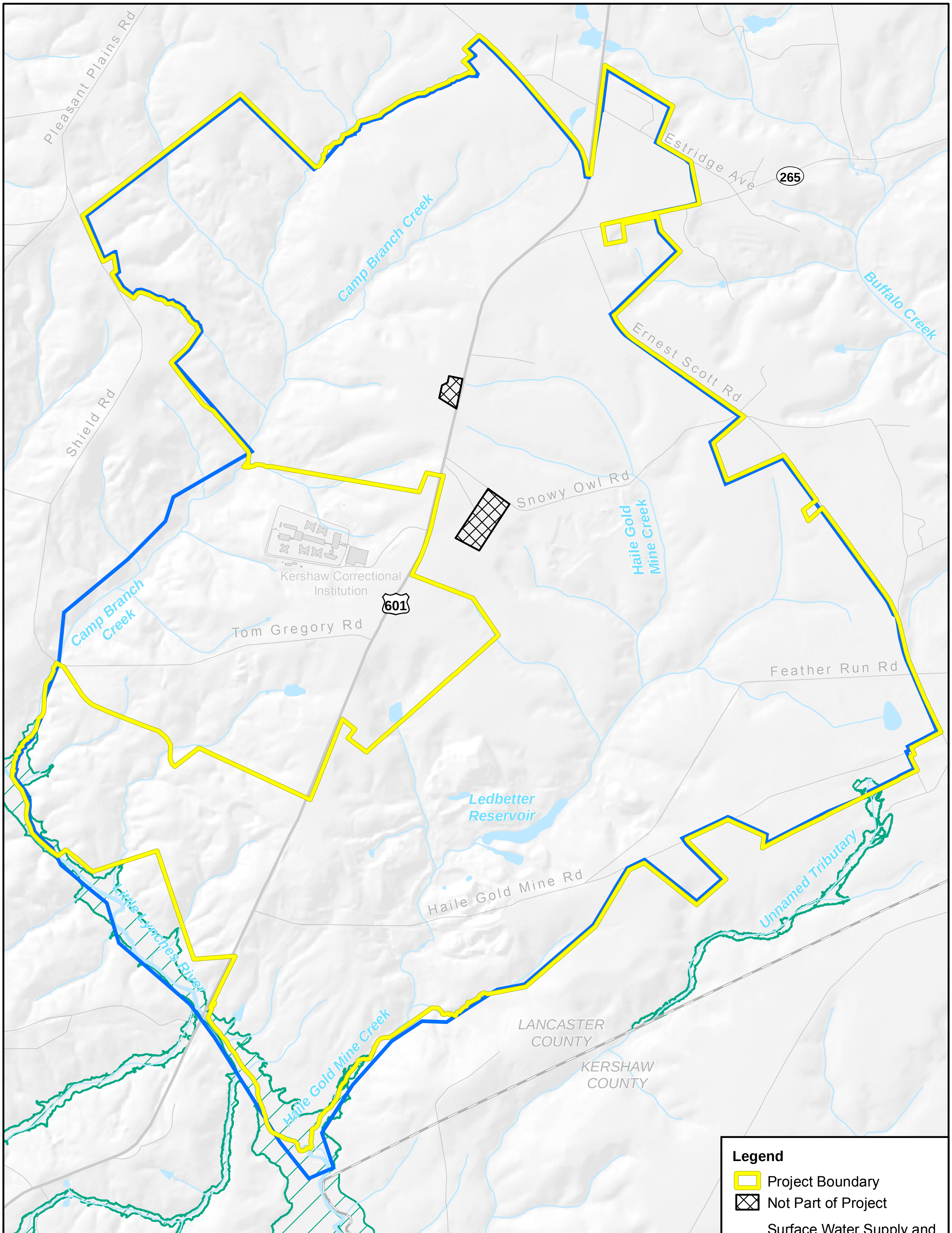


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Figure 3.5-6

**FEMA Zone A Floodplains in the Study Area**

0 1,000 2,000 Feet

0 300 600 Meters

Sources: ESRI 2008, FEMA 2011, SCDNR 2012.

For areas designated as Zone A, base flood elevations have not yet been determined by FEMA, meaning that the maps are approximations of where actual floodplain boundaries may lie (FEMA 2013). Generally, subregional hydrologic models are used to better define floodplain elevations and boundaries at a local scale. An analysis of the potential impacts of the Project on the regulated floodplains in the Project area is provided in Section 4.5.

The estimated 100-year flood event in the Little Lynches River, immediately downstream of the Project area tributaries, is approximately 8,300 cfs (ERC 2013). At this flow, the water surface elevation is estimated to be more than 4 feet lower than the surface elevation of all mining activities in the Project area (ERC 2013).

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# 3.6 Wetlands and Other Waters of the United States

This section describes the extent, location, community type, and function of jurisdictional wetlands and other waters of the United States (streams, rivers, ponds, and lakes referred to as "Waters of the U.S.") that occur in the study area and have the potential to be directly or indirectly affected by the Project. *Wetlands* are defined as:

> *…Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions…* (33 CFR 328.3[b]).

*Other waters of the United States* are defined as:

> *1. All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; 2. All interstate waters including interstate wetlands; 3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds,…; 4. All impoundments of waters otherwise defined as waters of the United States under this definition; 5. Tributaries of waters identified in this section; 6. The territorial sea; and 7. Wetlands adjacent to waters identified in paragraphs 1 through 6 of this section* (40 CFR 230.3[s]).

The proposed Project consists of a number of activities that would result in direct and indirect impacts on Waters of the U.S., details of which are described in Section 4.6. This section provides baseline characterization of wetlands and streams with the potential to be affected by the Project. Given the magnitude of potential impacts associated with the Project (as described in Section 4.6), baseline assessments are provided for wetlands and streams inside the Project boundary (the Project area) and an extended area outside the Project boundary that includes the Project area (the study area[1]). The limits of both the Project area (Project boundary) and study area are shown in Figure 3.6-1.

It is important to note that the baseline conditions for wetlands and streams and potential impacts on those resources take into consideration other resources that are interrelated, including geology and soils, surface water and groundwater hydrology and water quality, and aquatic resources. Baseline conditions and impact assessments for these interrelated resources are outlined in Sections 3.2 and 4.2, "Geology and Soils"; 3.3 and 4.3, "Groundwater Hydrology and Water Quality"; 3.4 and 4.4, "Surface Water Hydrology and Water Quality"; 3.5 and 4.5, "Water Supply and Floodplains"; and 3.7 and 4.7, "Aquatic Resources." Section 4.6 discusses Project-related impacts on wetlands and stream resources.

Appendix K provides supporting information and analysis for wetlands and Waters of the U.S.

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[1] The limits of the study area were defined by the maximum zone of influence (in Mine Year 14), when potential drawdown from groundwater lowering activities could affect wetlands and streams outside the Project boundary (see Section 4.3, "Groundwater Hydrology and Water Quality" for additional discussion).

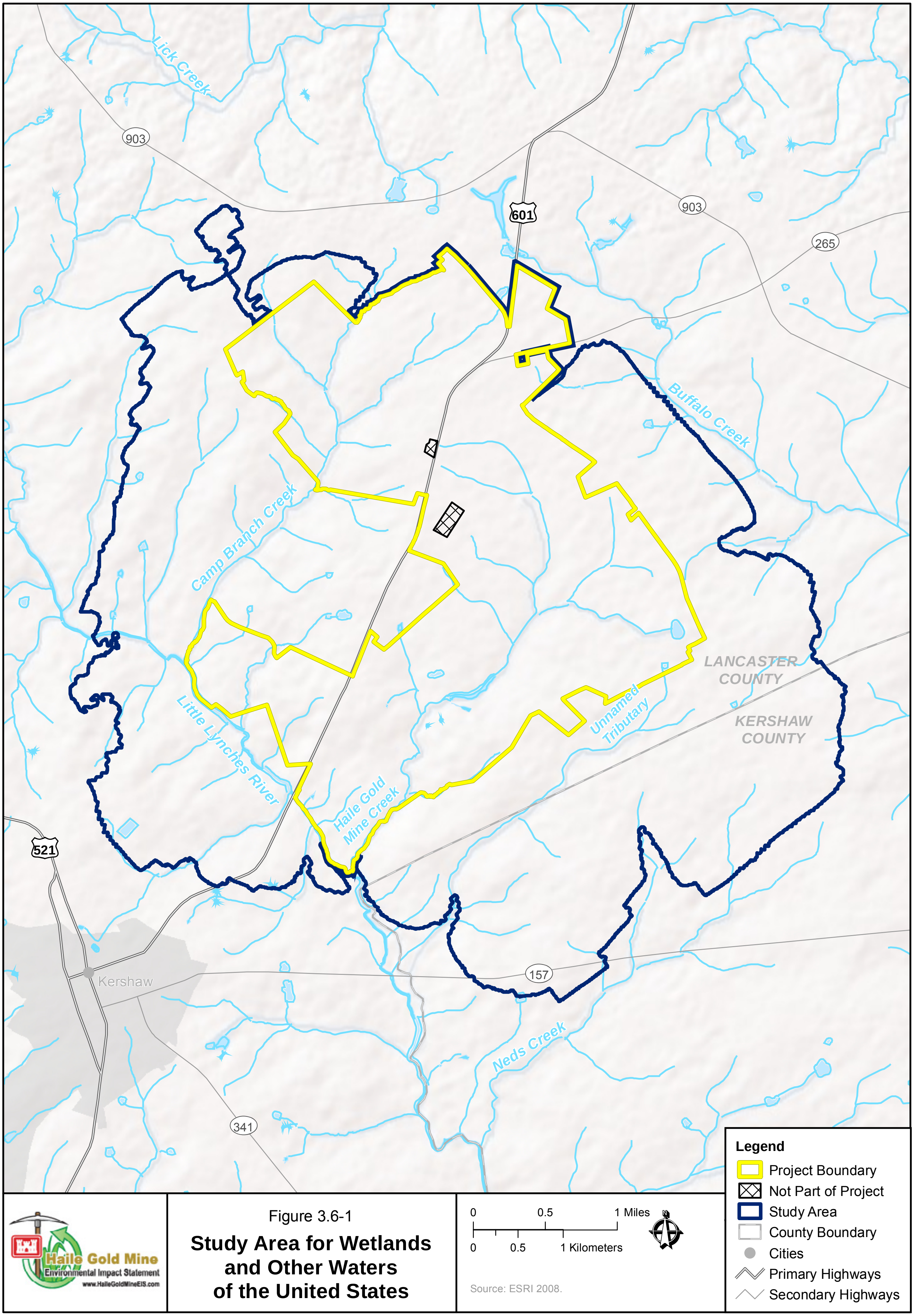


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Figure 3.6-1

**Study Area for Wetlands and Other Waters of the United States**

### 3.6.1 Regulatory Setting

The following federal and state regulations govern activities that could affect wetlands and Waters of the U.S. in the study area. Appendix F contains further details on regulations that apply to the proposed Project.

- **Clean Water Act Section 404 –** Section 404 of the CWA establishes a regulatory program by which the USACE regulates the discharge of dredge and fill material into Waters of the U.S., including wetlands as defined above, through issuance of DA permits. The responsibility for administering Section 404 guidelines is shared and enforced by the USACE and the USEPA. The USEPA has delegated the majority of Section 404 administration to the USACE, including individual permit decisions and jurisdictional determinations; policy and guidance development; and enforcement of Section 404 provisions. The USEPA continues to develop and interpret Section 404 criteria used in evaluating permit applications, identifies activities that are exempt from permitting, reviews and comments on individual permit applications, enforces Section 404 provisions, and has authority to veto USACE permit decisions.

  Under Section 404(b)(1) guidelines, applicants for a DA permit must first demonstrate that no other practicable alternative exists that would cause less adverse impact on the aquatic system, so long as the alternative does not cause other significant adverse environmental consequences. The project must demonstrate that appropriate practicable steps have been taken to minimize potential adverse impacts on the aquatic ecosystem. The project must also demonstrate that it does not violate state water quality or toxic effluent standards, jeopardize the continued existence of endangered or threatened species, or cause or contribute to significant degradation of the Waters of the U.S. Once these criteria are met, compensatory mitigation is then required to offset unavoidable impacts on aquatic resources to meet the programmatic goal of "no overall net loss" of aquatic resources. To ensure compliance with the "no net loss" policy, the USACE and the USEPA developed the *Compensatory Mitigation for Losses of Aquatic Resources, Final Rule* (Final Mitigation Rule) under 33 CFR 325 and 332 (USACE and USEPA 2008a).

- **Section 401 Water Quality Certification –** The SCDHEC administers the Water Quality Certification program pursuant to Section 401 of the CWA. For activities that require a federal permit, Section 401 requires the State to issue water quality certification for any activity that may result in discharge to waters of the state. For purposes of the Section 401 Water Quality Certification, the South Carolina Pollution Control Act (SCPCA) defines *waters of the State* as:

  > *…Lakes, bays, sounds, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic Ocean within the territorial limits of the State and all other bodies of surface or underground water, natural or artificial, public or private, inland or coastal, fresh or salt, which are wholly or partially within or bordering the State or within its jurisdiction…* (SCPCA Section 48-1-10).

  The SCDHEC must take action on all 404 permit applications. Under Section 404(b)(1) guidelines, "No discharge of fill material shall be permitted if it violates State water quality or toxic effluent standards." Therefore, the Water Quality Certification must show that all applicable effluent limitations and water quality standards would be met. The DA permit cannot be issued until Water Quality Certification is granted.

- **Rivers and Harbors Act Section 10 –** Similar to Section 404, Section 10 of the Rivers and Harbors Appropriation Act (1899) also regulates discharge of dredge and fill material in any navigable water of the United States (33 USC 403) and is enforced by the USACE.

*Navigable waters of the United States* are defined as:

> *…Those subject to the ebb and flow of the tide shoreward to the mean high water mark and/or presently used, or have been used in the past, or are susceptible for use to transport interstate or foreign commerce. The term includes coastal and inland waters, lakes, rivers and streams that are navigable, and the territorial seas.* (33 CFR 329.3)

*Revised Guidance on CWA Jurisdiction Following the Supreme Court Decision in Rapanos v. US and Carabell v. US* (USACE and USEPA 2008b) also was applied in evaluating final jurisdiction of non-tidal waters that are considered traditional navigable waters[2] (TNWs). The closest TNW is the Lynches River, which is located 25 miles downstream of the Project site. The "recommended and practical limit of navigable waters of the United States" has been identified at the confluence of the Little Lynches River and the Lynches River (USACE 1977) which is located outside the Project boundary and study area. Therefore, Section 10 does not apply to the proposed Project.

### 3.6.2 Existing Conditions

For purposes of evaluating potential adverse impacts on wetlands and streams, the USACE follows a watershed approach to ensure that quality and quantity of wetlands and other aquatic resources are maintained and improved in the same watershed as the impacts in order to comply with the no net loss policy and criteria outlined in the Final Mitigation Rule (USACE and USEPA 2008a). Consequently, watersheds have been defined for all Waters of the U.S. in the study area.

The proposed Project is located in the Lynches River watershed associated with HUC 03040202, as shown in Figure 3.6-2. The proposed Project also occurs in the two ecoregions shown in Figure 3.6-2 (Griffith et al. 2002). The majority of the Project area occurs in the Upper Coastal/Sandhills ecoregion, and the southwest corner of the Project area is located in the Piedmont/Carolina Slate Belt ecoregion. The ecoregions also closely align with the surficial geology shown in Figure 3.6-3, where the Upper Coastal ecoregion generally coincides with CPS, and saprolite dominates the surficial layers within the Piedmont ecoregion. The upper west portion of the Project area drains primarily through Camp Branch Creek, which flows from the northwest portion of the Project area to the confluence of the Little Lynches River, approximately 2 miles southwest of the Project boundary. The Little Lynches River borders the southern Project boundary from the west side of US 601 and flows to the southeast. The central portion of the Project area drains primarily through Haile Gold Mine Creek, which flows southwest from the northeast into the Little Lynches River.

All of the wetland and streams in the Project area and surrounding watersheds are considered headwater systems, which are often small with minimal flow, yet critical to the health of entire river network and downstream communities. Headwater streams are the beginnings of rivers, the uppermost streams in the river network farthest from the river's endpoint or confluence with another stream. They make up approximately 53 percent of the total stream miles in the United States and provide many upstream and downstream benefits. Headwater streams may flow year-round (perennial systems), but almost 60 percent of stream miles in the continental United States flow only seasonally or after storms (USEPA 2013).

[2] *Traditional navigable waters* (TNWs) include all navigable waters of the United States and all other waters that are navigable-in-fact. Waterbodies that are subject to the ebb and flow of the tide—and those that are, have been, or could be used to transport interstate or foreign goods—are considered TNWs.

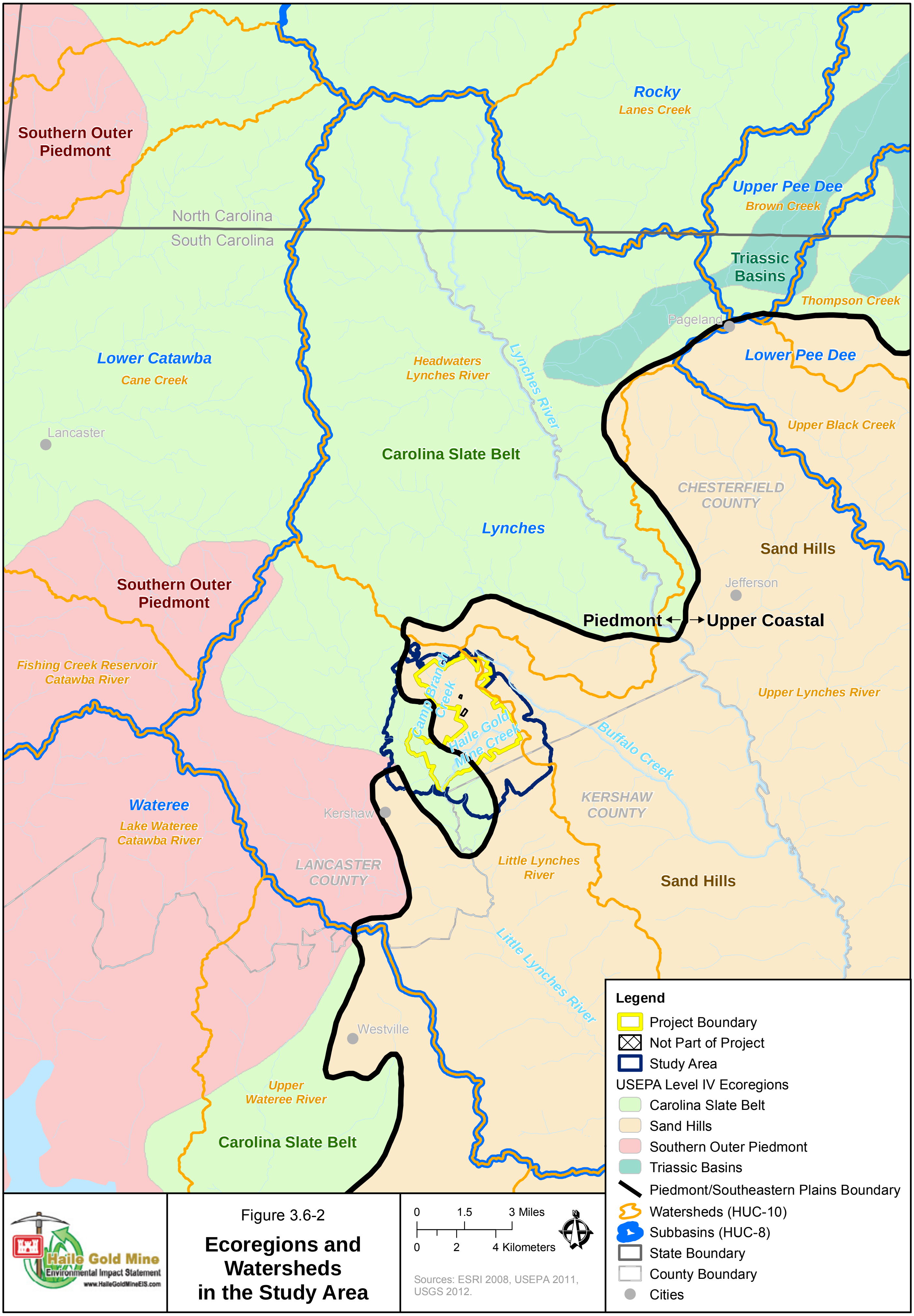


Figure 3.6-2

**Ecoregions and Watersheds in the Study Area**

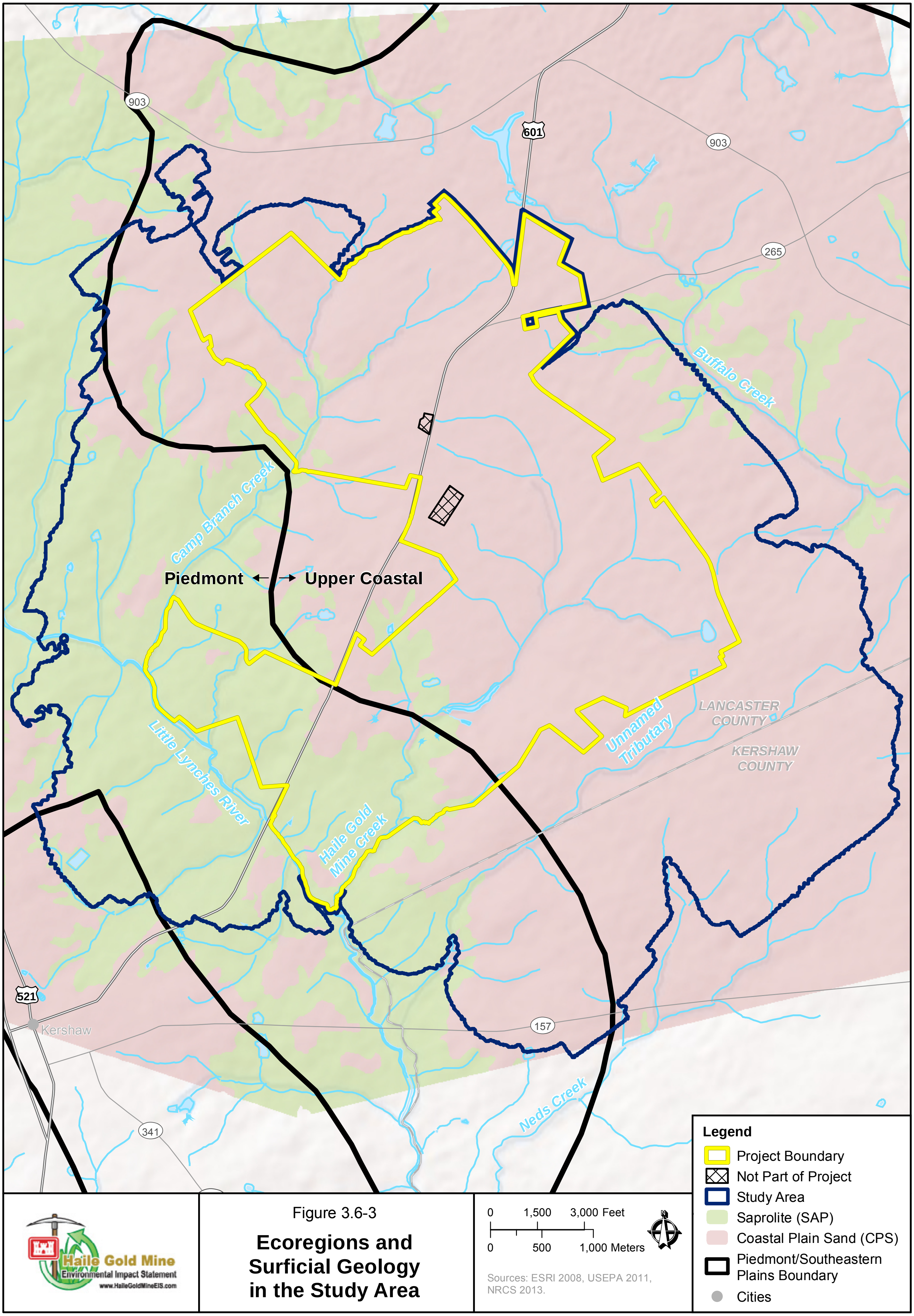


Figure 3.6-3

**Ecoregions and Surficial Geology in the Study Area**

Sources: ESRI 2008, USEPA 2011, NRCS 2013.

Headwater streams trap floodwaters; filter pollutants and recycle potentially harmful nutrients; provide fish and wildlife habitat; and sustain the health of downstream rivers, lakes, and bays. These streams also play a critical role in maintaining the quality and supply of drinking water, ensure a continual flow of water to surface waters, and help to recharge underground aquifers. Because small streams and streams that flow for only part of the year are the source of the nation's fresh waters, changes that harm these headwaters affect streams, lakes, and rivers downstream (USEPA 2013).

Given the significance of headwater wetlands and streams, baseline conditions for these systems were carefully evaluated to ensure that any structural or functional losses associated with the proposed Project were adequately quantified and compensated for. Baseline conditions for all wetlands and streams were characterized following a multi-step approach, as outlined below:

- Jurisdictional determinations were conducted to establish the extent of wetlands and Waters of the U.S. in the Project area that are subject to federal regulation based on the USACE's delineation methodology. Wetlands and streams within the study area (outside the Project boundary) also were evaluated, but formal jurisdictional determinations were not conducted for these areas because of access limitations. These areas were evaluated through a desktop mapping exercise (aerial interpretation) relying on publicly available resources and databases.
- Wetland habitat classifications were conducted to enable quantification of habitat loss types and to ensure that in-kind mitigation (discussed in Section 4.6) is provided where applicable.
- Completing an overview of existing hydrologic regimes for wetlands and streams enabled evaluation of potential indirect impacts associated with Project-related activities (Appendix K1).

This baseline characterization was used to quantify loss of wetland and stream resources associated with the Project to ensure that adequate mitigation is provided consistent with the USACE and USEPA policy of no net loss of aquatic resources (discussed in Section 4.6). The results are summarized below.

#### 3.6.2.1 Extent of Wetlands and Waters of the United States

Detailed field assessments were conducted for wetlands and streams in the Project area to enable a more thorough assessment of baseline conditions. Different methodologies were used for the study area. Assessment was largely conducted through as desktop mapping exercise because of access limitations outside the Project boundary. Methods used to determine the extent of Waters of the U.S. in the Project area and study area are described below.

##### Jurisdictional Determinations in the Project Area

To evaluate the potential for adverse impacts on wetlands as required under CWA regulations, the jurisdictional limits (boundaries) of Waters of the U.S. first had to be established in accordance with criteria specified in the *Corps of Engineers Wetland Delineation Manual* (Wetland Delineation Manual) (USACE 1987) and in the *Interim Regional Supplement to Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (Interim Regional Supplement) (USACE 2010b). USACE staff conducted field verifications in support of jurisdictional determinations on August 20, 2009; November 22, 2010; March 22, 2011; April 26 and 27, 2011; April 5, 2012; and July 24 and 25, 2012.

The USACE evaluates three parameters that must be present for wetland jurisdiction to be assumed: (1) hydrophytic vegetation; (2) hydric soils; and (3) evidence of hydrology. Jurisdiction of non-vegetated areas that meet the criteria of Waters of the U.S. includes "surface waters such as rivers, streams and their tributaries, all wetlands adjacent to these waters, and all ponds, lakes and reservoirs" (USACE 1987). The jurisdictional extent of these areas often are determined by the ordinary high water mark, which is characterized as

> *…The line on the shores established by the fluctuations of water and indicated by physical characteristics such as: a clear natural line impressed on the bank, shelving, changes in the character of the soil, wetland vegetation, the presence of litter and debris, and other appropriate means that consider the characteristics of the surrounding areas* (USACE 1987).

### *Hydrophytic Vegetation*

Vegetation in the jurisdictional review areas was carefully evaluated at pre-selected data sampling plots to determine whether the community contained more than 50 percent hydrophytic vegetation with facultative (FAC), facultative wetland (FACW), or obligate (OBL) indicator status,[3] as outlined in the *National Wetland Plant Lists* (USFWS 1997; Lichvar 2012). The observations were cross-referenced with findings outlined in the USACE Wetland Determination Data Forms and Stream Data Assessment Sheets provided by the Applicant.

### *Hydric Soils*

Soils associated with wetland habitats within the Project boundary were mapped and classified in accordance with the NRCS Soil Survey Geographic Database (NRCS 2013). Figure 3.6-4 illustrates the hydric soils in the study area. By definition in the Wetland Delineation Manual, *hydric soils* are "saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" (USACE 1987). Soils within wetland and stream habitats also were evaluated (at pre-selected data sampling points) during the agency field verifications to confirm whether hydric soil conditions were present, consistent with NRCS maps and findings outlined in the Wetland Determination Data Forms approved by the USACE (2012) and the Low Gradient Stream Assessment Data Sheets provided by the Applicant (Blauch 2012).

As shown in Table 3.6-1 and Figure 3.6-4, a total of nine hydric soil types were found in the study area (excluding areas mapped as water); most of the hydric soil types overlap the headwaters and stream corridors identified under the jurisdiction of the USACE. Of these hydric soil types, Chewacla soils, Johnston loam, Rutlege loamy, and Worsham fine sandy loam are the most prominent, as detailed in Table 3.6-1. Soils are discussed in more detail in Section 3.2, and descriptions of the most prominent hydric soil types associated with the Project are summarized below.

#### Chewacla

The Chewacla soils are considered partially hydric and occur both in the Project area and study area. These soils are found in floodplains and were formed from various sediments deposited by running water. They are somewhat poorly drained soils, with a high water capacity and able to sustain approximately 12 inches of water. These soils also have moderately high to high hydraulic conductivity and are generally found in flat areas with a 0- to 2-percent slope.

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3 *Obligate (OBL) wetland species* occur more than 99 percent of the time only in wetlands. *Facultative wetland (FACW) species* occur in wetlands from 67 to 99 percent of the time. *Facultative (FAC) species* are tolerant of wet and dry conditions, and are found in wetlands from 34 to 66 percent of the time.

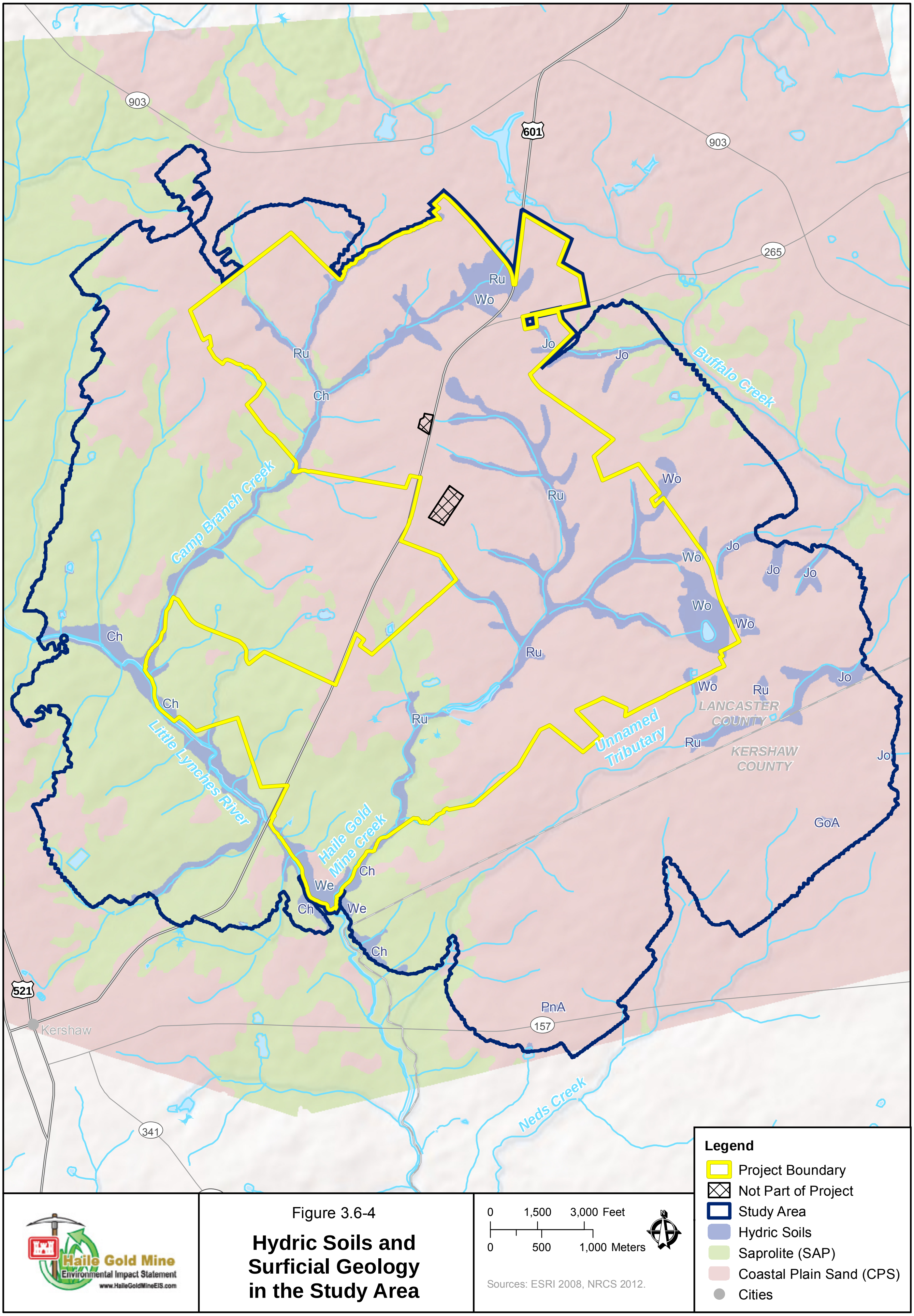


Figure 3.6-4

**Hydric Soils and Surficial Geology in the Study Area**

### Table 3.6-1 Hydric Soil Types in the Study Area

| Soil Type[a] | Map Unit Name | Hydric Status | Acres within Project Area | Acres within Study Area | Total |
|---|---|---|---|---|---|
| Ch | Chewacla soils | Partially hydric[b] | 86.8 | 187 | 273.8 |
| Ch | Chewacla loam | Partially hydric[b] | None | 12.1 | 12.1 |
| GoA | Goldboro loamy sand | Partially hydric[b] | None | 2.4 | 2.4 |
| Jo | Johnston loam | Hydric | 5.6 | 88.0 | 93.6 |
| PnA | Pelion loamy sand | Partially hydric[b] | None | 2.5 | 2.5 |
| Ru | Rutlege loamy sand | Hydric | 301.6 | 27.0 | 328.6 |
| W | Water | Hydric | 6.3 | 8.2 | 14.5 |
| We | Wehadkee and Chewacla soils | Partially hydric[a] | 3.6 | 4.5 | 8.1 |
| We | Wehadkee silt loam | Partially hydric[b] | None | 0.8 | 0.8 |
| Wo | Worsham fine sandy loam | Hydric | 90.5 | 29.2 | 119.7 |
| **Total** | | | **494.4** | **361.7** | **856.1** |

[a] Soil types are based on Natural Resource Conservation Service soil maps.

[b] Not hydric in entirety but has hydric inclusions.

### *Johnston*

Johnston loam is considered a hydric soil and is primarily found more commonly associated with wetlands and streams within the study area. These soils are commonly found in the floodplains of the Coastal Plain. They are very poorly drained soils with low water capacity and are able to sustain approximately 6 inches of water. The soils also have high hydraulic conductivity and occur in nearly level areas with a 0- to 2-percent slope.

### *Rutlege*

Rutlege loamy sands are considered hydric and are primarily associated with wetlands and streams in the Project area, but also occur in the study area. They are commonly found in depressions and flood plains and were formed from sandy marine deposits. They are very poorly drained soils with a low water capacity, able to sustain 4 inches of water. The soils also have high (to very high) hydraulic conductivity and generally are found in flatter areas with a 0- to 2-percent slope.

### *Worsham*

Worsham fine sandy loam is considered a hydric soil type; it is primarily associated with wetlands and streams in the Project area but also occur in the study area. These soils are found in depressions and were formed from clay sediments deposited by running water. The soil type is poorly drained, with a moderate water capacity and able to sustain approximately 8 inches of water. The soil also has very low to moderately low hydraulic conductivity and occurs in relatively flat areas with 0- to 2-percent slope.

### *Hydrology*

Hydrologic indicators also were evaluated in the field specific to surface water, groundwater, and soils. As referenced in the USACE's Interim Regional Supplement (2010), hydrologic indicators must demonstrate a continuing wetland hydrologic regime based on timing, duration, and frequency of wet conditions to show that hydric soils and hydrophytic (water-loving) vegetation exist based on current conditions and not historical water regimes. Hydrologic indicators were evaluated at pre-selected data sampling points to verify findings outlined in the USACE Wetland Determination Data Forms and Stream Assessment Data Sheets provided by the Applicant.

In addition to the above-referenced criteria, *Revised Guidance on CWA Jurisdiction Following the Supreme Court Decision in Rapanos v. US and Carabell v. US* (USACE and USEPA 2008b) was considered in evaluating final jurisdiction of non-tidal waters based on connectivity to TNWs. As part of the jurisdictional determination for streams, the streams were classified according to stream type. The classification used a combination of the Strahler method (Strahler 1952) and Rosgen's *Field Guide for Stream Classification* (Rosgen 1996 and 1998).

## Summary of Jurisdictional Wetlands and Waters of the United States in the Project Area

The USACE issued final jurisdictional approval (SAC-1992-24122-4JH) in a letter dated October 1, 2012 (USACE 2012). As outlined in Table 3.6-2, the USACE identified a total of 337.71 acres of jurisdictional wetlands and Waters of the U.S., consisting of wetlands, streams, and jurisdictional impoundments in the Project area. The limits of jurisdiction include 294.09 acres of wetlands and 43.62 acres of jurisdictional waters that comprise 31.25 acres of streams (measuring 100,279.22 linear feet) and 12.37 acres of impoundments. Under CWA guidance, jurisdictional wetlands include wetlands that are directly contiguous to seasonal or perennial relatively permanent waters (RPWs) (streams) that flow directly or indirectly into TNWs.

The Lynches River is the closest TNW (located 25 miles downstream). It is directly connected to jurisdictional waters in the Project area via the Little Lynches River, which is classified as a perennial RPW. All of the wetlands in the Project area are considered headwaters of the stream systems or riparian wetlands that primarily occur along the stream corridors. Jurisdictional waters in the Project area generally consist of streams that are classified as seasonal and perennial RPWs that flow directly or indirectly into TNWs, in addition to impoundments (Ledbetter Reservoir) of seasonal and perennial RPWs. The majority of streams in the Project area are classified as perennial systems, including the Little Lynches River, Haile Gold Mine Creek, Camp Branch Creek, and Champion Branch Creek. Some of the upper reaches, headwaters, and tributaries of these main arterial stream systems are classified as seasonal RPWs. Only two of the stream reaches in the Project area are classified as non-RPWs.

In addition to the streams, five open water impoundments were designated as jurisdictional waters. These impoundments historically were part of the stream systems and were converted to impoundments through the use of control structures. In some cases, these impoundment features also were subjected to historical mining.

Other water features (sediment basins, treatment ponds, and pit lakes) totaling 23.49 acres were evaluated and determined to be non-jurisdictional based on CWA regulations. Table 3.6-2 summarizes the jurisdictional findings for wetlands, streams, and impoundments. The locations of jurisdictional wetlands and Waters of the U.S. are depicted in Figure 3.6-5 and on the Jurisdictional Waters of the U.S. and Wetland Delineation Map (Sheet Key and Sheets 1 through 7) that was approved by the USACE (USACE 2012).

**Table 3.6-2 Types of Jurisdictional Wetlands and Other Waters of the United States in the Project Area**

| USACE Jurisdiction | Types of Jurisdictional Features | Acres[a]/ Linear Feet[b] |
|---|---|---|
| Wetlands | Wetlands abutting or adjacent to RPWs | 294.09 acres |
| Other Waters of the U.S. | Jurisdictional Impoundments (of RPWs) | 12.37 acres |
| **Total Jurisdictional Wetlands and Impoundments (inside the Project Boundary)** | | **306.46 acres** |
| Other Waters of the U. S. | Perennial Streams (RPWs) | 78,168.26 LF |
| | Seasonal Streams (RPWs) | 15,070.52 LF |
| | Non-RPW Streams | 7,040.44 LF |
| **Total Jurisdictional Streams (inside the Project boundary)** | | **100,279.22 LF/ 31.25 acres[b]** |
| **Total Waters of the U.S. (inside the Project boundary)** | | **337.71 acres** |

RPW = relatively permanent water

a Wetlands and open water areas quantified by acres.

b Streams quantified by linear feet (totals 31.25 acres).

## Approximate Extent of Wetlands and Other Waters of the United States outside the Project Boundary

Because of access limitations, formal wetland delineations could not be conducted in the portion of the study area that is outside the Project boundary. Therefore, the approximate extent of wetlands and Waters of the U.S. outside the Project boundary were determined through a desktop mapping exercise relying on a combination of publicly available databases, including the SCDNR hydrography and GAP databases (SCDNR 2013a, 2013b), the USFWS National Wetland Inventory (NWI) database (USFWS 2013), the NRCS Soil Survey Geographic Database (NRCS 2013), and the 2006 National Land Cover Database published by Multi-Resolution Land Characteristics Consortium (Fry et al. 2011). For purposes of this mapping exercise, all streams were assumed to be RPWs that ultimately connect to a TNW downstream (the Lynches River), and wetlands were considered abutting or adjacent to these RPWs. However, the jurisdictional extent of open water areas (impoundments) and flow regimes of streams (perennial) cannot be confirmed without field verification.

The approximate extent of wetlands and streams outside the Project boundary are shown in Figure 3.6-6. As summarized in Table 3.6-3, a total of approximately 849.92 acres of wetlands and 63.23 acres of Waters of the U.S. occur in the portion of the study area that is outside the Project boundary. In this area, the approximate extent of Waters of the U.S. consists of 32.23 acres of open water areas and 31 acres of streams (~135,023.06 linear feet), which primarily are associated with the Little Lynches River, Camp Branch Creek, a few headwater tributaries of Buffalo Creek and Ned's Creek, and a number of unnamed tributaries that serve as headwaters of the Little Lynches River. Hydric soils in the study area that are shown in Figure 3.6-4 do not correlate closely with the wetlands and streams shown in Figure 3.6-6.

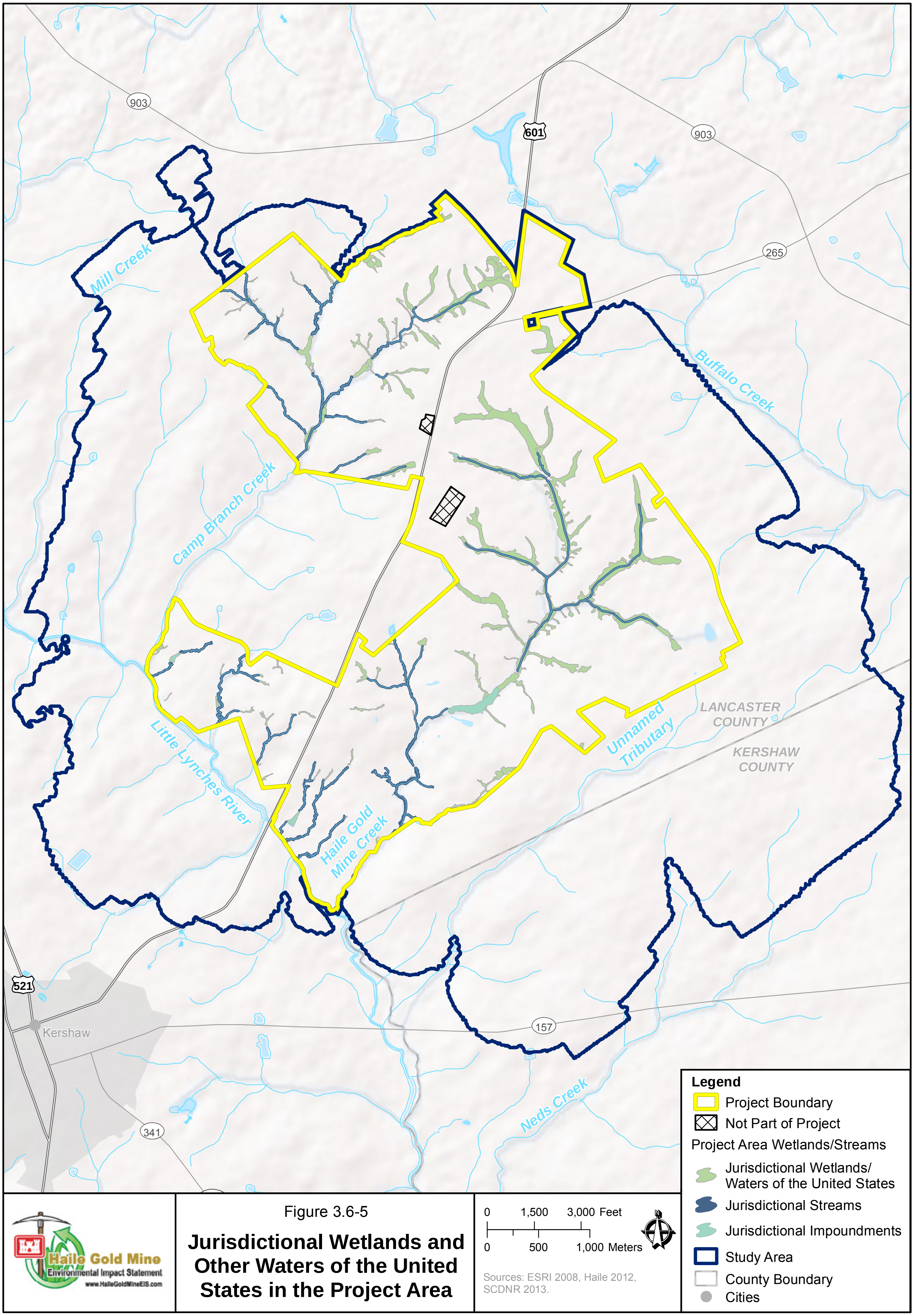


Figure 3.6-5

**Jurisdictional Wetlands and Other Waters of the United States in the Project Area**

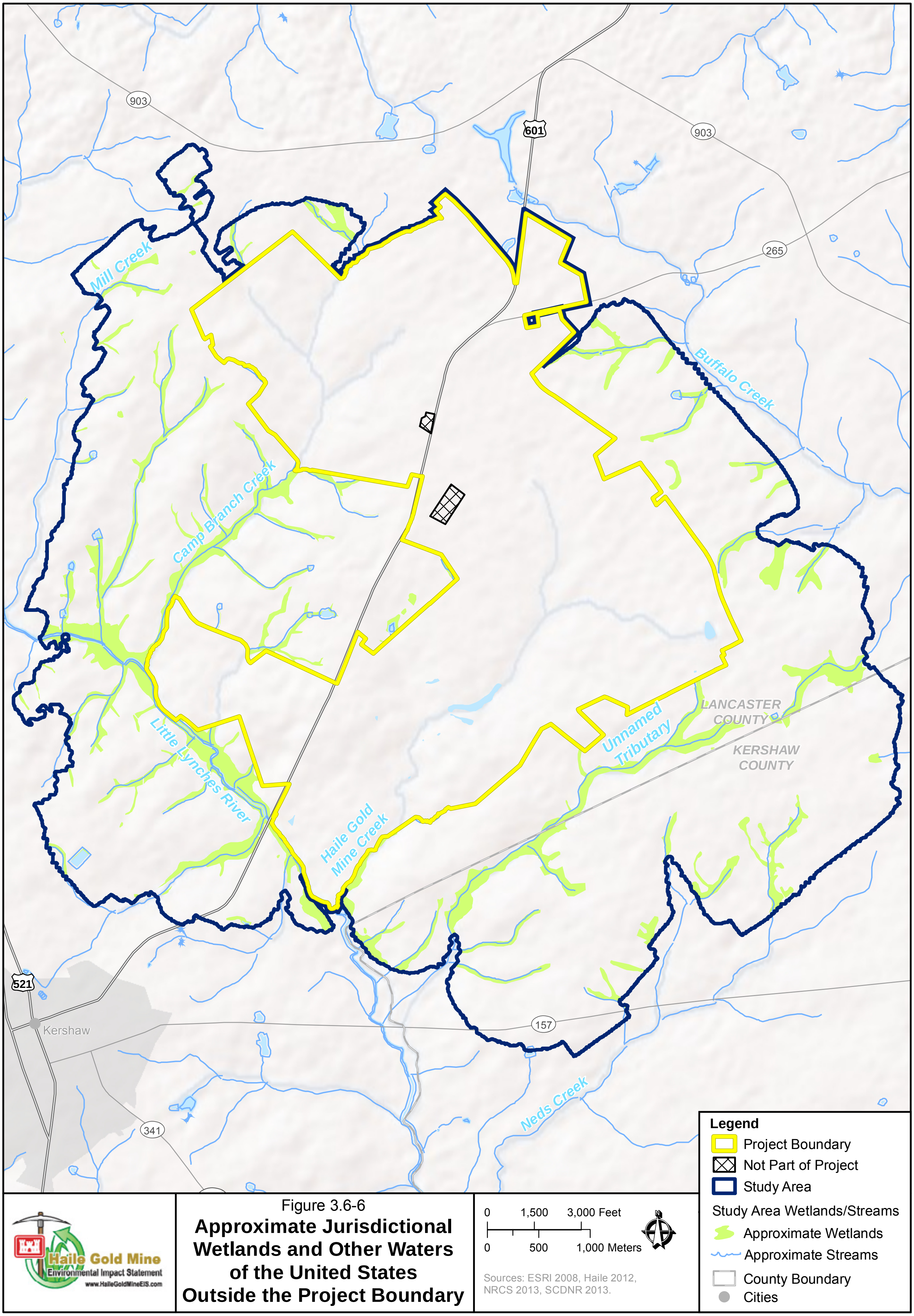


Figure 3.6-6

**Approximate Jurisdictional Wetlands and Other Waters of the United States Outside the Project Boundary**

### Table 3.6-3 Summary of Approximate Wetlands and Other Waters of the United States outside the Project Boundary

| USACE Jurisdiction | Types of Jurisdictional Features | Acres[a]/ Linear Feet[b] |
|---|---|---|
| Wetlands | Wetlands (abutting or adjacent to RPWs) | 849.92 acres |
| Other Waters of the U.S. | Open water areas (abutting RPWs) | 32.23 acres |
| **Total Wetlands and Open Waters outside the Project Boundary** | | **882.15 acres** |
| Other Waters of the U.S. | Streams (RPWs) | 135,023.06 LF[b] |
| **Total Streams outside the Project Boundary** | | **135,023.06 LF/ 31.0 acres[b]** |
| **Total Waters of the United States outside the Project Boundary** | | **913.15 acres** |

RPW = relatively permanent water

[a] Wetlands and open water areas are quantified by acres.

[b] Streams are quantified by linear feet (LF) (totals 31.0 acres).

## Wetland Habitat Types

Wetland habitats were characterized using two distinct classification systems: (1) the Hydrogeomorphic Classification of Wetlands (HGM classification system) (Brinson 1993); and (2) Classification of Wetlands and Deepwater Habitats of the United States (Cowardin classification system) (Cowardin et al. 1979). The HGM classification system is used to group wetlands by their hydrologic functions based on geomorphic setting, water source, and hydrodynamics—which will later be used to assess potential impacts from drawdown (Section 4.6, ). The Cowardin classification system is used to characterize wetlands based on vegetative community types to ensure that in-kind mitigation is provided to compensate for specific habitat losses (palustrine forested wetlands for the proposed Project). Similar to the jurisdictional determinations described in Section 3.6.2.1, wetland habitats in the Project area were mapped through detailed ground-truthing evaluations and were field verified by USACE staff during the site reviews conducted for the jurisdictional determinations. Wetland habitats in the portion of the study area that is outside the Project boundary were mapped through a desktop exercise because of access limitations. Below is an overview of the habitats characterized based on the two classification systems.

## HGM Classification System

The HGM classification system (Brinson 1993) was developed by the USACE Waterways Experiment Station as a foundation for wetland assessment. It is used as a wetland classification system based on geomorphic position and hydrologic characteristics to group wetlands into seven different wetland classes as defined by Brinson (1993) that include depressional, riverine, mineral flats, organic flats, tidal fringe, lacustrine fringe, and slopes. The wetlands associated with this Project are grouped under three of these wetland classes: slope wetlands, riverine wetlands, and depressional wetlands. Approximately 90 percent of wetlands associated with the Project (1,137.69 acres) are considered slope wetlands and include all palustrine forested and palustrine scrub-shrub wetlands, as outlined in Table 3.6-4. All riverine wetlands associated with streams are grouped under riverine HGM class, and the palustrine emergent or open water systems fall under the HGM class of depressional wetlands.

## Table 3.6-4 Summary of Jurisdictional Wetland Habitats Associated with the Project

| HGM Class[a, b] | Cowardin Habitat Type[a, c] | Acres/Linear Feets inside the Project Boundary[d] | Acres/Linear Feet outside the Project Boundary[e] | Total Wetland Acres/Linear Feet |
|---|---|---|---|---|
| **Wetlands** | | | | |
| Slope | Palustrine forested (PFO) | 271.23 | 824.94 | 1,096.17 acres |
| Slope | Palustrine scrub-shrub (PSS) | 16.76 | 24.76 | 41.52 acres |
| Depressional | Palustrine emergent (PEM) | 6.1 | 0.22 | 6.32 acres |
| ***Total Wetlands*** | | ***294.09*** | ***849.92*** | ***1,144.01 acres*** |
| **Other Waters of the United States (Impoundments and Open Water Areas)** | | | | |
| Depressional | Palustrine Open Water (POW) | 12.37 | 32.23 | 44.6 acres |
| ***Total Other Waters of the United States (Impoundments and Open Water Areas)*** | | ***12.37*** | ***32.23*** | ***44.6 acres*** |
| **Other Waters of the United States (Streams)** | | | | |
| Riverine | Riverine Lower Perennial (R2) | 78,168.26 | 135,023.06[f] | 212,171.06 LF |
| Riverine | Riverine Intermittent (R4) | 22,110.96 | -- | 22,110.96 LF |
| ***Total Other Waters of the United States (Streams)*** | | ***100,279.22 LF/ 31.25 acres*** | ***135,023.06 LF/ 31.0 acres*** | ***235,302.28 LF/ 62.25 acres*** |
| **Total Waters of the United States Associated with the Project** | | **337.71** | **913.15** | **1,250.86 acres** |

a Figure K-1 in Appendix K shows the locations of these wetlands.

b Hydrogeomorphic class (Brinson 1993)

c Cowardin identifiers (Cowardin et al. 1979):

PFO = palustrine forested
PEM = palustrine emergent
PSS = palustrine scrub-shrub
POW = palustrine open water
R2 = riverine (low gradient and slow velocity)
R4 = riverine flowing for part of the year

d Jurisdictional wetland acres inside the Project boundary; wetlands are quantified by acres, and streams are quantified by linear feet (LF).

e Approximate wetland acres located in the study area outside the Project boundary; wetlands are quantified by acres, and streams are quantified by linear feet (LF).

f Streams located outside the Project boundary were mapped through aerial interpretation. The flow regime cannot be defined without field verification; therefore, streams were mapped as perennial systems but may include seasonal streams.

- **Slope Wetlands** – Slope wetlands are found in association with groundwater discharges to the land surface or sites with saturated overflow and no channel formation. They are normally found on sloping land where elevation gradients may range from steep hillsides to slight slopes, although they also can occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Hydrodynamics are dominated by downslope unidirectional water flow. The predominant source of water is groundwater or interflow discharging at the land surface as well as precipitation. Slope wetlands are usually incapable of depressional storage because they lack the necessary closed contours. They lose water primarily by saturated subsurface flows and by evapotranspiration. Slope wetlands may develop channels; however, the channels serve only to convey flows away from the slope wetland.

The majority of wetlands associated with the proposed Project are classified under the HGM subclass of headwater slope wetlands, which occur primarily as linear drainages within a flat or rolling upland landscape. Headwater slope wetlands are located in headwater areas above and including 1st- and 2nd-order streams, for which groundwater is the primary input. However, the stream channels carry water away from them rather than delivering water to them, which differentiates them from the riverine subclass (Noble et al. 2011). More details pertaining to the hydrology of slope wetlands are provided in Section 3.6.2.3. Slope wetlands associated with the Project also are classified as palustrine forested and scrub-shrub systems (Cowardin et al. 1979). Other names used to refer to wetlands in the regional subclass include bayheads, bay galls, springheads, and steepheads.

- **Riverine Wetlands** – Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface groundwater connections between the stream channel and adjacent wetlands. With overbank flow, hydrodynamics often are dominated by surface flows down the floodplain. Additional water sources may include interflow, overland flow from adjacent uplands, tributary inflow, and precipitation. Riverine headwater wetlands often integrate with slope or depressional wetlands, poorly drained flats, or uplands as the channel (bed) and bank disappear. Perennial flow is not required in these HGM classes. They tend to lose surface water via return of floodwater to the channel after flooding and through surface flow to the channel during rainfall events. They also lose subsurface water by discharge to the channel, movement to deeper groundwater, and evaporation. More details pertaining to the hydrology of streams (designated as riverine per HGM classification) are provided in Section 3.6.2.3. For purposes of this Project, the riverine wetlands consist of the Little Lynches River and all the stream systems in the study area, including Haile Gold Mine Creek, Camp Branch Creek, Ned’s Creek, Mills Creek, and their associated tributaries.
- **Depressional Wetlands** – Depressional wetlands occur in topographic depressions with a closed elevation contour that allows accumulation of surface water. Dominant sources of water are precipitation, overland flow, streams, groundwater discharge, and interflow from adjacent uplands. Flow typically originates from higher elevations and is directed to the center of the depression. Hydrodynamics typically fluctuate vertically and range from diurnal to seasonal. Depressional wetlands may have any combination of inlets and outlets, or lack them completely. The depressional wetlands in the Project area are not isolated (they contain both inlets and outlets); however, they occur in topographic depressions that allow accumulation and storage of water. They may lose water through evapotranspiration, intermittent or perennial outlets, or recharge to groundwater. For purposes of this Project, the depressional wetlands are primarily associated with palustrine emergent and open water systems.

### Cowardin Classification System

The USFWS developed the Cowardin classification system (Cowardin et al. 1979) as a standardized method to classify or describe wetlands and deepwater habitats throughout the United States. Wetland habitats found in the Project area were classified into two major systems: palustrine and riverine. The majority of wetlands (approximately 88 percent) associated with the Project are considered palustrine forested wetlands, as detailed in Table 3.6-4.

- **Palustrine Wetlands –** The majority of the wetlands associated with the Project consist of palustrine systems. Palustrine systems are all non-tidal wetlands dominated by trees, shrubs, persistent emergents,[4] emergent mosses, or lichens and all such tidal wetlands where ocean-derived salinities are below 0.5 parts per thousand (ppt). The palustrine category encompasses wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie. This category also includes wetlands lacking such hydric vegetation but with all of the following characteristics: (1) the area is less than 20 acres; (2) the area lacks an active wave-formed or bedrock boundary; (3) water depth in the deepest part of the basin is less than 6.6 feet at low water; and (4) ocean-derived salinities are less than 0.5 ppt.

  Palustrine wetlands associated with the Project were divided into five classes based on vegetative form: palustrine forested (PFO), palustrine scrub-shrub (PSS), palustrine emergent (PEM), and palustrine open water (POW). The majority of wetlands in the Project area are dominated by palustrine forested communities, as outlined in Table 3.6-4. The hydrologic regime also was established under Cowardin to distinguish between saturated, seasonally flooded, semi-permanently flooded and permanently flooded. The majority of wetlands in the Project area fall under the category of saturated and seasonally flooded. Figures 3.6-7 to 3.6-11 are representative photographs of the predominant wetland habitats found in the Project area and are also typical of slope wetlands. Appendix K provides a more detailed description of the palustrine classifications, including the modifiers used to characterize hydrologic regimes.

- **Riverine Wetlands –** All of the headwater streams associated with the Project are characterized as riverine systems under Cowardin. *Riverine systems*, as defined by Cowardin, are all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens; and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppm. A *channel* is “an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water” (Cowardin et al. 1979). The palustrine wetlands occur in close association with these riverine systems stream systems.

  Riverine systems were further classified into two subsystems: lower perennial (R2) and intermittent (R4) based on water permanence, gradient, water velocity, substrate, and the extent of floodplain development. The USACE jurisdictional streams designated as perennial RPWs are classified as lower perennial riverine systems; they have slow water velocity, and the gradient is low compared to upper perennial streams (R3). All other streams designated as seasonal RPWs (or Non RPWs) under USACE designation are classified as intermittent riverine systems as they have flowing water for only part of the year. Figures 3.6-9 and 3.6-10 depict the palustrine forested wetlands (slope wetlands) flanking either side. These photographs are representative of the headwater wetlands and stream systems that occur throughout the Project area.

Table 3.6-4 summarizes all the habitat types associated with jurisdictional wetlands and Waters of the U.S. found in the study area based on the Cowardin classification system. The locations of these wetlands are shown on the wetland habitat classification map included as Figure K-1 in Appendix K.

[4] An *emergent* plant is an erect plant that is rooted in water and grows above the water’s surface.

Figure 3.6-7 Typical Palustrine Forested System (Saturated)

Figure 3.6-8 Typical Palustrine Forested System (Seasonally Flooded)

Figure 3.6-9 Lower Portion of Haile Gold Mine Creek (south of Ledbetter Reservoir) – Typical Perennial Stream with Palustrine Forested Wetlands on Either Side

Figure 3.6-10 Upper Camp Branch Creek – Typical Perennial Stream with Palustrine Forested Wetland on Either Side

Figure 3.6-11 Typical Intermittent (Seasonal) Stream with Palustrine Forested Wetland on Either Side

### 3.6.2.2 Wetland Hydrology

Hydrology is ultimately what supports a wetland based on the USACE's definition:

> *Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions…*
> 33 CFR 328.3[b]).

Given the potential for wetlands to be adversely affected by groundwater lowering activities, this subsection characterizes baseline hydrology to ensure that any structural or functional losses (permanent or temporal) associated with the proposed Project are addressed.

Wetland conditions occur where topographic and hydrogeologic conditions are favorable and a sufficient, long-term source of water exists. *Favorable topographic conditions* refer generally to the presence of land-surface depressions in the drainage basin. These depressions may be located in upland areas, along hillsides where there may be a change in slope or geology, in floodplains of streams or rivers, or along the margins of lakes. Geologic conditions that may be favorable for wetland development include areas with fine-textured surficial soils of low hydraulic conductivity and sufficient thickness to store water. The presence of impermeable bedrock near the land surface also may favor the development of wetland hydrology.

As noted, development of wetland conditions requires a persistent, long-term source of water. Sources of water may include precipitation that falls directly on the wetland, surface water runoff during rainfall or snowmelt events within the catchment area surrounding the wetland (surface water inflow), periodic flooding caused by elevated water levels in nearby surface waterbodies, groundwater inflow to the wetland, or a combination of any or all of these sources. Water may be lost from a wetland by evaporation from standing water or saturated soils, transpiration from plants, or surface water or groundwater outflow. The development of wetland conditions depends on a long-term balance between water inflow to the wetland and outflow from the wetland. During dry climatic periods, the rate of water inflow to the wetland (precipitation, groundwater inflow, and surface or near-surface inflow) may greatly diminish. In this instance, the amount of water lost through evapotranspiration may exceed the rate of all water inflow to the wetland. Water losses through evapotranspiration can result in extreme declines in the water table and desaturation of the wetland.

As described in Section 3.3, “Groundwater Hydrology and Water Quality,” the Project is located in the Piedmont physiographic province of the southeastern United States, which predominantly consists of saprolite (USGS 2009). However, the site lies in the Sand Hills region that forms the border between the Coastal Plain and Piedmont in South Carolina. Overall, geology in the Project area is characterized by fractured crystalline bedrock that is overlain by saprolite and alluvial CPS deposits, as depicted in Figure3.6-3. The saprolite tends to occur predominantly on the lower-lying areas of the Project area to the south, and CPS occurs on the topographically higher areas to the north. Likewise, the groundwater table tends to sit closer to the surface in the lower-lying areas where saprolite is more prevalent at the surface. In the topographically high areas of the site where CPS is more prevalent, the water table sits farther below the surface. Overall, the groundwater table generally occurs no more than 30 feet below the surface and follows the topography of the site.

The Groundwater Modeling Summary Report (Cardno ENTRIX 2013) (Appendix I) indicates that neither the saprolite nor the CPS includes effective confining units, and that both the shallow and deep aquifers are hydraulically connected. Data from the Groundwater Modeling Summary Report indicates that the shallow CPS aquifer in this region has high permeability, in which case, water moves downward into the underlying saprolite zone. Where present, the saprolite partially separates the CPS aquifer from the underlying bedrock aquifer. Given the lower permeability of the saprolite, there is a tendency for some of the water to be deflected in a more horizontal direction, with the result that components of flow tend to parallel the ground surface. Although the saprolite generally consists of clay with low primary permeability, it is cut by numerous quartz-rich dikes that are intensely fractured and serve as conduits for vertical flow through the saprolite. As a result, the saprolite has higher vertical hydraulic conductivity than expected and is not an effective confining unit in spite of the clay-rich matrix of the unit. The permeability of the bedrock underlying the saprolite is highly variable and in some cases exceeds that of the CPS. However, water movement in the bedrock underlying the saprolite is primarily restricted to flow through fractures (USGS 2009). The typical flow patterns in these surficial aquifers are depicted in Figure 3.6-12.

Water enters the ground in recharge areas at the land surface in the upland areas of the watershed and percolates vertically downward through the unsaturated zone. Once the water reaches the saturated zone, or water table, it moves laterally to points of discharge at springs, seeps, or baseflows to streams or lakes, as depicted in Figure 3.6-12 (USGS 2009). The distribution of discharge is believed to be variable along the run of the creeks and is controlled by the hydraulic conductivity of the aquifer and its connection to surface waters. The magnitude of groundwater discharge from the bedrock aquifer to the surface water system is variable with distribution of cracks in the bedrock and continuity of the saprolite layer being important to vertical hydraulic conductivity.

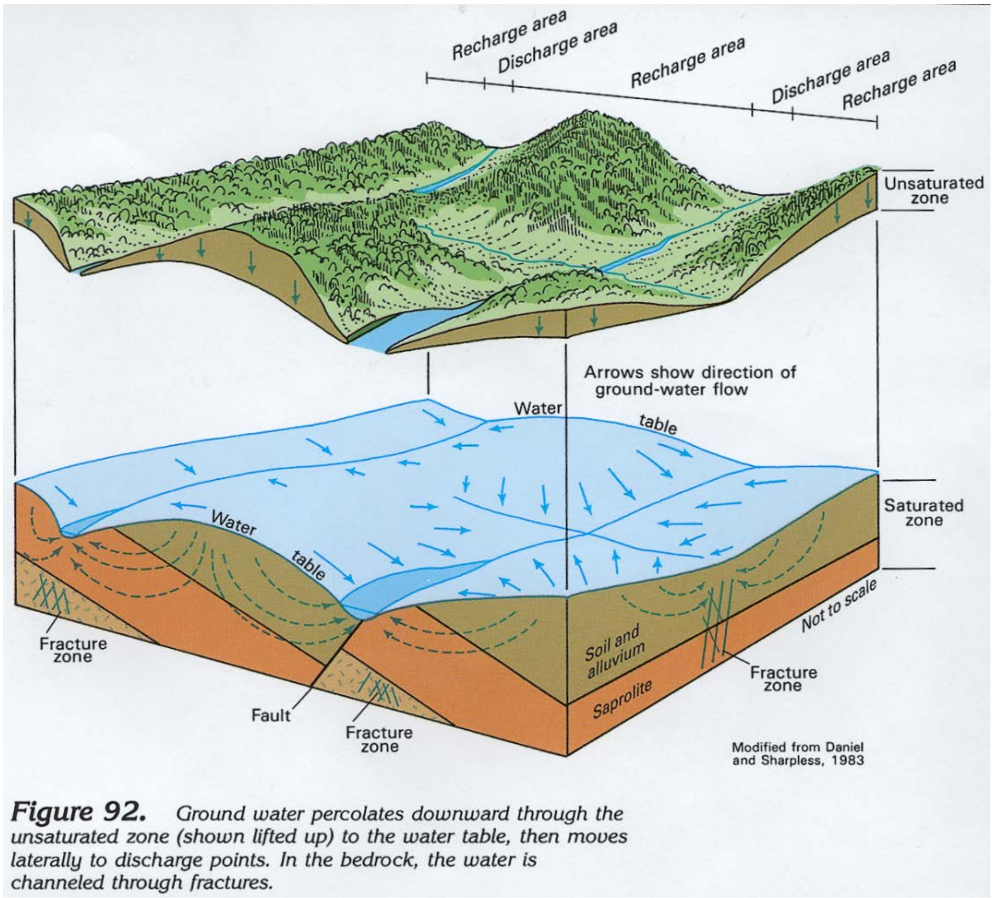


Figure 3.6-12 Typical Water Flow Associated with Saprolite and Coastal Plain Sands in the Piedmont Aquifer

Source: USGS 2009.

Wetlands in the Project area consist of headwater systems that feed into small tributaries (headwater streams) that discharge into the arterial stream systems (Haile Gold Mine Creek and Camp Branch Creek) and ultimately the Little Lynches River. As outlined in Section 3.6.6.2, these wetlands are primarily characterized as slope wetlands, consistent with the HGM classification terminology (Brinson 1993; Smith et al. 2013; Noble et al. 2007); they are seepage systems that are fed primarily by groundwater where it discharges at the land surface. Precipitation from overland flow is a secondary contributing source of water; however, precipitation is the sole source of recharge for groundwater as it infiltrates at the land surface and moves in a unilateral, downgradient direction. The downgradient portion of these systems typically have a narrow ephemeral channel that serves to convey water away from the wetland, rather than overbank flow that often occurs with riverine systems. Slope wetlands lose water primarily by saturated subsurface flows, low-order streams, and evapotranspiration (Noble et al. 2011; Noble et al. 2007). Most wetlands in the Project area occur on well-defined slopes and lose water by small streams. Those that occur along somewhat larger streams are at least partially in flatter landscapes, and some of their water likely is supplied by the stream system. The hydrologic regime is consistent throughout the Project area although there are some variations in groundwater flow conditions relative to surficial geology, as illustrated in Figures 3.6-13 through 3.6-15.

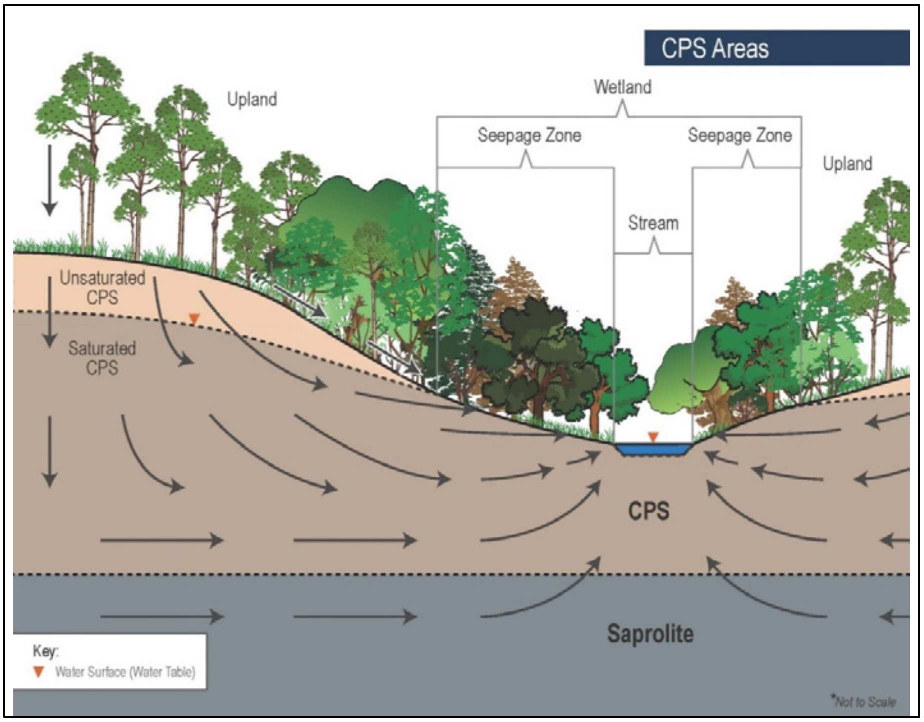


Figure 3.6-13 Hydrologic Regime of Headwater Seepage Wetlands and Streams in Coastal Plain Sands (CPS) Areas Associated with the Project

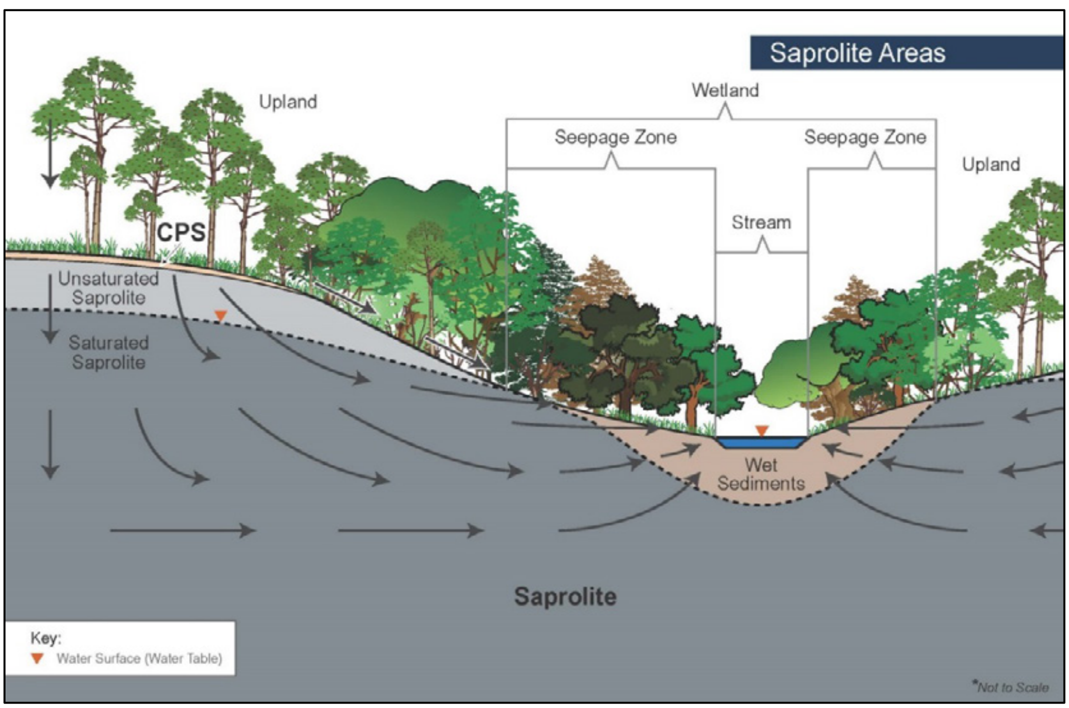


Figure 3.6-14 Hydrologic Regime of Headwater Seepage Wetlands and Streams in Saprolite Areas Associated with the Project

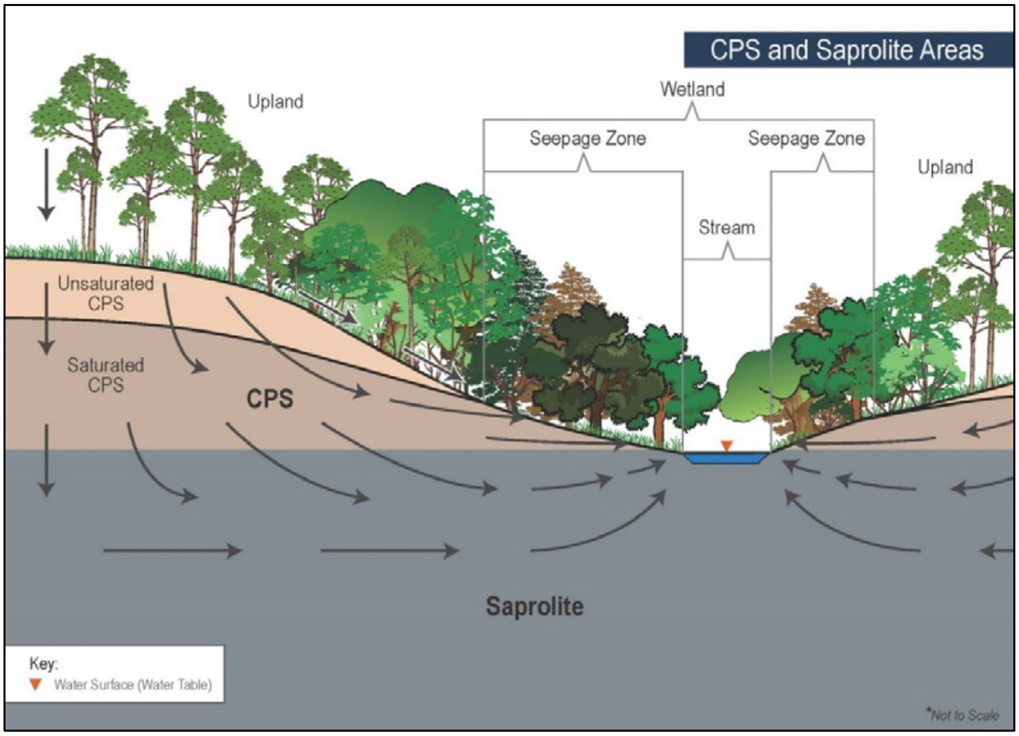


Figure 3.6-15 Hydrologic Regime of Headwater Seepage Wetlands and Streams in Coastal Plain Sands (CPS) and Saprolite Areas Associated with the Project

The persistence, size, and function of wetlands are controlled largely by hydrologic processes (Carter 1996). For example, the persistence of wetness for many wetlands is dependent on a relatively stable influx of groundwater throughout changing seasonal, annual, and multi-year climatic cycles. Characterizing groundwater discharge to wetlands and its relation to such environmental factors as moisture content and chemistry in the root zone of wetland plants is a critical, but difficult to characterize, aspect of wetlands hydrology (Hunt et al. 1999). No published studies were identified that provide actual hydrologic data or references to such data for the Sand Hills region; however, several studies pertaining to slope wetlands in this region note the presence of seepage, mineral soils, long-term saturation, and minimal water level fluctuation (for instance, see Kinser et al. 1995, 2003, 2006).

The amount of water available to a slope wetland depends on topography and the extent and height of the upslope groundwater mound. Seepage wetlands will not always have constant flow and may experience seasonal variability (Tiner 2005). If the mound is adequately extensive and the surficial materials are highly permeable, there may be nearly continuous water supply to the wetland, and in most such cases, there is likely to be organic soil formation. Where there is less of a groundwater mound, the wetland may experience extended periods of dryness and organic soils will be lacking. The slope wetlands present in the Project area appear to vary with landscape location. The wetlands in lower-lying areas generally receive more water than those near the uppermost extents of the wetlands. More details on the baseline hydrologic conditions of wetlands are addressed in the Technical Memorandum prepared by Cardno ENTRIX (Appendix K-1) for purposes of evaluating indirect wetland impacts associated with groundwater lowering in Section 4.6.

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# 3.7 Aquatic Resources

Aquatic resources include the current physical environment (streamflow, stream bottom composition, stream width, and riparian vegetation) and the associated biological assemblages or communities (the species composition) of various waterbodies within the resource study area. Additional discussion of waterbodies in the Project area and the surrounding watersheds can be found in Sections 3.1, “Introduction and Physical Setting”; 3.3 and 4.3, “Groundwater Hydrology and Water Quality”; 3.4 and 4.4, “Surface Water Hydrology and Water Quality”; and 3.6. and 4.6, “Wetlands and Other Waters of the United States.” Appendix L contains supporting information and additional detail about aquatic resources.

Potential Project-related impacts on aquatic resources include direct and indirect impacts caused by filling of portions of streams including headwaters, diversion and detention of Haile Gold Mine Creek, reductions in runoff or stream baseflow, alteration of the existing flow regimes, alteration of the stream morphology or structure, stream diversions (e.g., culverts and pipes), draining or filling of existing lakes and ponds, and changes to water quality.

In areas where streams would be filled, direct habitat loss for aquatic species may occur, as well as alterations in downstream flow and associated stream morphological features. The proposed detention structure and diversion of Haile Gold Mine Creek would affect the flow regime and stream connectivity of the creek. Construction of the TSF would permanently fill and alter portions of upper Camp Branch Creek. This would result in flow regime changes through a reduction in contributing watershed area. Section 4.7 discusses Project-related impacts on aquatic resources.

The study area for aquatic resources extends beyond the Project boundary to include portions of the Little Lynches River, Buffalo Creek, and an Unnamed Tributary. These waterbodies are included in the study area because of the potential for groundwater lowering to indirectly affect their baseflow regimes. Because of their proximity to the Project boundary, the information available from habitat assessment surveys, local fish surveys, migratory fish surveys, benthic macroinvertebrate surveys, and herpetological surveys that have been conducted in these streams is relevant. Downstream portions of the Lynches River are included in the study area because they were surveyed for freshwater mussels, including the Carolina heelsplitter. All of the data collected during surveys in the aquatic resources study area have been used to define pre-Project conditions. Figure 3.7-1 illustrates the waterbodies in the aquatic resources study area.

## 3.7.1 Regulatory Setting

- **Magnuson-Stevens Fishery Conservation and Management Act and Essential Fish Habitat (EFH)** – The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth a mandate for the National Marine Fisheries Service (NMFS), regional fishery management councils (FMCs), and other federal agencies to identify and protect important marine and anadromous fish habitats. The EFH provisions of the Magnuson-Stevens Act support one of the Nation's overall marine resource management goals - maintaining sustainable fisheries. Federal action agencies that fund, permit, or carry out activities that may adversely affect EFH are required to consult with NMFS regarding the potential impacts of their actions on EFH, and respond in writing to NMFS or recommendations. Measures recommended by NMFS or an FMC to protect EFH are advisory, not proscriptive.

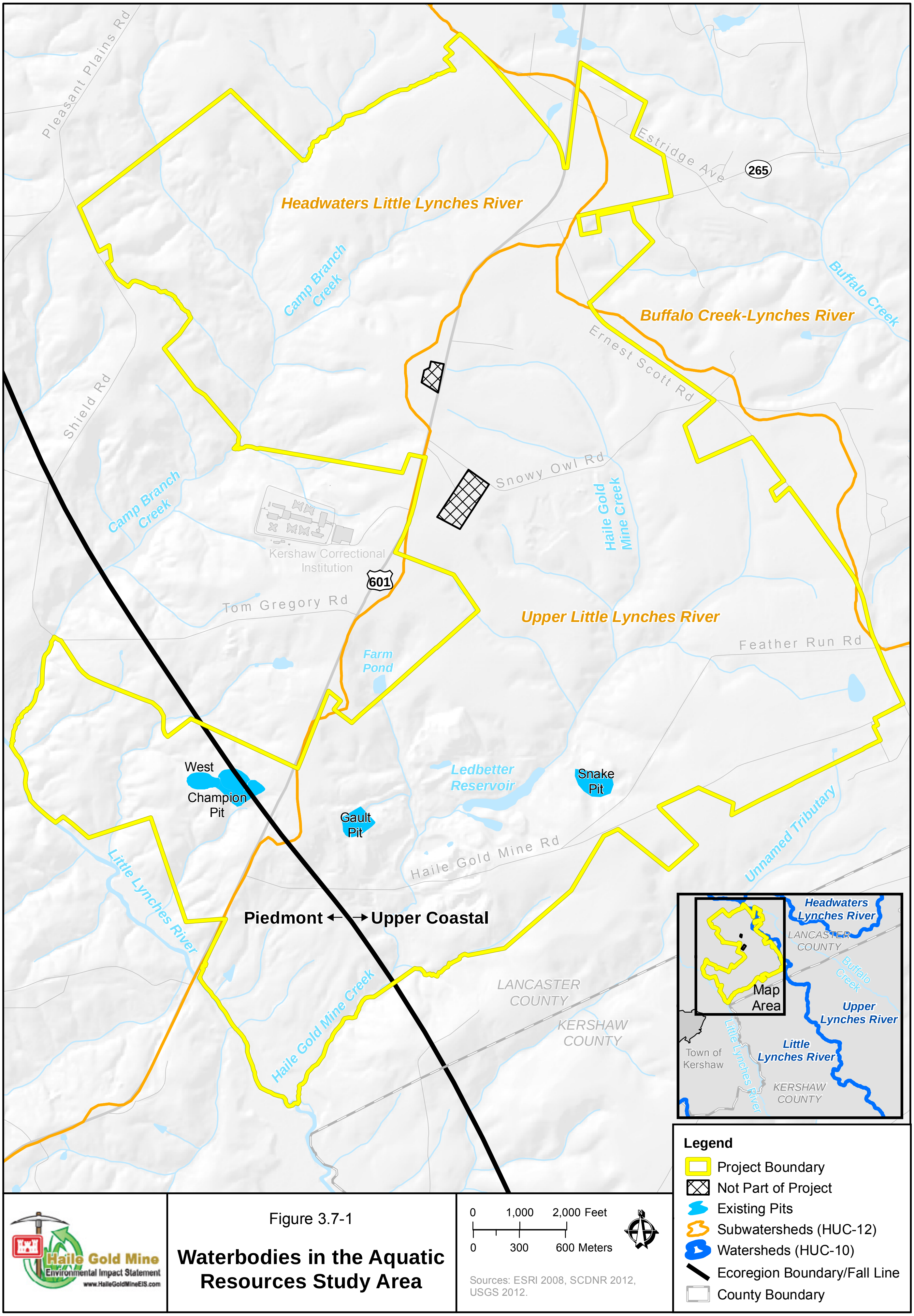


Figure 3.7-1

**Waterbodies in the Aquatic Resources Study Area**

- **South Carolina Priority Species** – As part of the Comprehensive Wildlife Conservation Strategy adopted by the SCDNR, a list was created of species of concern, termed the South Carolina Priority Species List. The list categorizes taxa as highest, high, or moderate priority (SCDNR 2005a). Eight criteria were used in determining priority species, and experts in their respective fields determined the conservation status of those priority species (SCDNR 2005a). The taxonomic groups that are part of the South Carolina Priority Species List covered in this chapter include herpetological species, freshwater and diadromous fish (fish that live in both saltwater and freshwater), and freshwater mussels.

### 3.7.2 Existing Conditions

The physical environment is discussed by waterbody type, including streams, rivers, creeks, man-made lakes, and wetlands. For each waterbody type, the documented and likely biological assemblages are discussed according to the following taxonomic groups:

- Fish
- Benthic macroinvertebrates[1]
- Freshwater mussels
- Amphibians and reptiles
- Aquatic vegetation
- Aquatic periphyton[2]

#### 3.7.2.1 Physical Environment

##### Streams

All streams within the study area are located in the Lynches River Subbasin HUC 030402-02 (Figure 3.7-1). The three waterbodies within the Project area are part of the Little Lynches River watershed (HUC-03040202-02): Camp Branch Creek, Haile Gold Mine Creek, and the Little Lynches River. Portions of reaches of Camp Branch Creek and Haile Gold Mine Creek are within both the Southeastern Plains-Sandhills and Piedmont-Carolina Slate Belt ecoregions (see Section 3.6.3). The more downstream sections of both streams are within the Piedmont region, as is the Little Lynches River just outside the Project boundary. The upper reaches and headwaters of Camp Branch Creek and Haile Gold Mine Creek lie within the Southeastern Plains ecoregion (Griffith et al. 2002).

Two other streams that lie outside of and close to the Project boundary were surveyed by ARCADIS in 2011 and 2012 as reference locations (locations that are more representative of a less altered environment). These include the Unnamed Tributary just south of Haile Gold Mine Creek, which partially intersects the Project boundary; and Buffalo Creek, which lies directly north/northeast of the Project boundary (Figure 3.7-1). Buffalo Creek is part of the Upper Lynches River (HUC-03040202-03) while the Unnamed Tributary flows into the Little Lynches River downstream of Haile Gold Mine Creek.

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[1] *Benthic macroinvertebrates* are animals without backbones larger than 0.5 millimeter that live on the bottom of a waterbody.

[2] *Aquatic periphyton* are algae, cyanobacteria, microbes, or detritus attached to submerged surfaces that serve as food sources to aquatic animals.

The Lynches River, which was surveyed during freshwater mussel surveys, may be outside the scope of indirect or cumulative impacts but is included in the study area due to the availability of biological data and the potential for some of the area surveyed to be enhanced as part of compensatory mitigation. The Lynches River included in the study area is part of the Middle Lynches River (HUC-03040202-05) and the Lower Lynches River (HUC-03040202-07). This portion of the river lies within the Southeastern Plains (Level III)-Atlantic Southern Loam Plains (Level IV) and the Middle Atlantic Coastal Plain (Level III)-Carolina Flatwoods (Level IV) ecoregions (Griffith et al. 2002). The farthest south sampling location is just downstream from the Lynches River State Park (Keferl and Shelly 1988).

The Little Lynches River is listed as a Section 303(d) stream with a secondary priority status (see Section 3.6 for information about secondary priority streams). Portions of Haile Gold Mine Creek and Camp Branch Creek also have a secondary priority status and are considered waters with state-listed rare or uncommon species (e.g., Sandhills chub and American eel). All other stream reaches are considered tertiary.

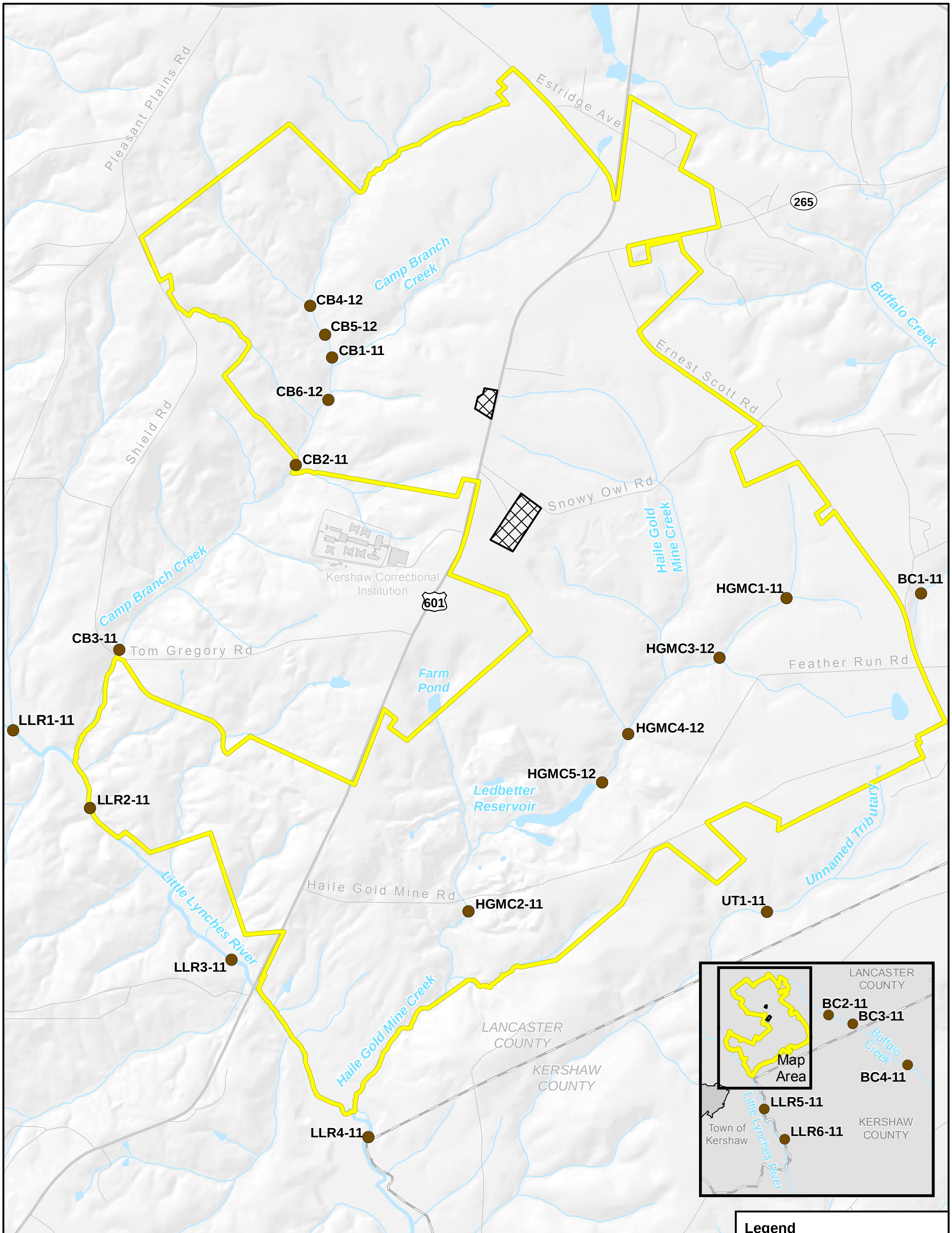
To characterize a stream and describe its current conditions, scientists collect and evaluate a number of physical and biological measurements. Over time, survey methods for physical characteristics have included the *EPA Rapid Bioassessment Protocols for Use in Streams and Rivers (*Barbour et.al. 1999), and *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC 1998). For each of these methods, the overall health and functionality of the stream can be determined based on measurements that are expressed as parameters or metrics.

Records on the physical attributes of Haile Gold Mine Creek begin in 1987, in conjunction with benthic macroinvertebrate sampling (Enwright Laboratories 1988a). During the most recent macroinvertebrate assessment in April 2011, the bottom substrate of Haile Gold Mine Creek upstream of Ledbetter Reservoir consisted mainly of gravel and sand (Figure 3.7-2). These reaches exhibited relatively clear water with slow flow (ETT 2011). The bottom substrate of Haile Gold Mine Creek immediately downstream of Ledbetter Reservoir was composed mainly of large rocks and then transitioned to hard, clayey mud (Figure 3.7-3) before turning to cobble (rock fragments between 64 and 256 millimeters [mm] in diameter)/gravel (unconsolidated rock fragments up to 2.5 inches in diameter), with clay present throughout (ETT 2011). The Camp Branch Creek upstream station was mainly silt, with slow-flowing water and slightly turbid conditions; the more downstream station was comprised of silt and gravel, with moderately swift flow.

All sections of the Little Lynches River were slightly turbid, with moderately swift flow. The bottom of the Little Lynches River upstream of Camp Branch Creek was silt and cobble/gravel; both upstream and downstream of Haile Gold Mine Creek, the bottom substrate was mainly silt with a mix of gravel or gravel/cobble. Figure 3.7-4 shows the locations of the habitat assessment surveys in the study area.

Figure 3.7-2 Haile Gold Mine Creek Upstream

Figure 3.7-3 Haile Gold Mine Creek at the Confluence with the Little Lynches River




Haile Gold Mine Environmental Impact Statement
www.HaileGoldMineEIS.com

Figure 3.7-4

**Locations of Habitat Assessment Surveys in the Study Area**

0 1,000 2,000 Feet
0 300 600 Meters

Sources: ARCADIS 2012ad, ESRI 2008.

**Legend**

- Project Boundary
- Not Part of Project
- All Habitat Assessment Sampling Locations
- County Boundary

A separate stream evaluation was conducted in by ARCADIS in October 2011 and April 2012 that followed the USEPA's *Rapid Bioassessment Protocol for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et.al. 1999). The range of scores for the USEPA's habitat assessment evaluation is from 0 to 200 and was the template for the USACE's assessment forms. In spring 2012, the new locations also were evaluated by ARCADIS according to SCDNR's *The South Carolina Stream Assessment Standard Operating Procedures* (Scott et al. 2011).

Camp Branch Creek and Haile Gold Mine Creek had a similar score range (from 111 to 143 and from 118 to 152, respectively), indicating impaired to fully functional conditions. Scores in the Little Lynches River were the lowest, with the narrowest range (94 to115) and an overall rating of impaired to partially impaired (ARCADIS 2012a, 2012b).

During the October 2011 survey, physical measurements for velocity, depth, and wetted width were averaged for the entire sampling reach (ARCADIS 2012a). The velocity in Camp Branch Creek was approximately 0.50 foot per second (ft/sec) at all locations, with a depth just under 0.50 foot. The wetted width in Camp Branch Creek ranged from 2.8 feet upstream to 10.6 feet downstream at CB3-11 (see Figure 3.7-4). Velocity was very different in the two reaches of Haile Gold Mine Creek. Velocity was very low (<0.01 ft/sec), and shallow water conditions (~0.15 feet deep) were observed in the more headwaters section of Haile Gold Mine Creek; the downstream section was similar to conditions observed in Camp Branch Creek (velocity of 0.56 ft/sec and depth of 0.43 feet). The wetted width for Haile Gold Mine Creek was 2.8 feet upstream and 5.6 feet downstream. In the Little Lynches River, velocity increased when traveling downstream; however, there was no visible trend in depth. Average depth in the most upstream location (upstream of Camp Branch Creek) was 11 feet and velocity was 0.13 ft/sec; at the most downstream location, average depth was 11 feet and velocity was 0.81 ft/sec. Wetted width for the Little Lynches River ranged from 18 to 25.6 feet. In the Unnamed Tributary, the average velocity was 0.21 ft/sec, depth was 0.41 foot, and wetted width was 4.6 feet. In Buffalo Creek, the only waterbody sampled outside of the Little Lynches drainage, the velocity was approximately 0.33 ft/sec and depth was between 0.44 and 0.61 feet. The wetted width for Buffalo Creek ranged from 10.2 to 16.1 feet (see Table 3.7-1).

**Table 3.7-1 Summary of 2011 and 2012 ARCADIS Surveys on Physical Characteristics of Streams**

| Waterbody | Velocity Range (feet/second) | Average Depth Range (feet) | Wetted Width Range (feet) | Bottom Substrate |
|---|---|---|---|---|
| Camp Branch Creek upstream | 0.48–0.89 | 0.39–0.66 | 2.8–11.1 | Gravel and sand (mix with large boulders exposed) |
| Camp Branch Creek downstream | 0.79 | 0.44 | 10.6 | Gravel and sand (mix) |
| Haile Gold Mine Creek upstream | < 0.01–0.72 | 0.15–0.92 | 2.8–6.1 | Sand |
| Haile Gold Mine Creek downstream | 0.56 | 0.43 | 5.60 | Gravel and cobble |
| Little Lynches River upstream | 0.13–0.25 | 0.67–0.95 | 18–24 | Gravel and sand (large gravel component) |
| Little Lynches River downstream | 0.30–0.81 | 0.55–0.94 | 18.4–25.6 | Gravel and sand (large gravel component) |
| Unnamed Tributary | 0.21 | 0.41 | 4.60 | Gravel and sand (equal) |
| Buffalo Creek | 0.33 | 0.44–0.61 | 10.2–16.1 | Gravel (dominant) and sand (smaller portion of stream bottom) |

Bottom substrate characteristics also were recorded during the habitat assessment for each stream reach. Haile Gold Mine Creek upstream was comprised mainly of sand; downstream of Ledbetter Reservoir, the bottom substrate was gravel and cobble. The three Camp Branch Creek reaches were dominated by a gravel and sand mix; larger boulders/bedrock were exposed in the upstream portion. The majority of the Little Lynches River was sand, with a fairly large gravel component (Figure 3.7-5).

Figure 3.7-5 Little Lynches River Downstream of US Highway 601

Buffalo Creek was dominated by gravel, and a smaller portion of the stream bottom consisted of sand. The bottom of the Unnamed Tributary (Figure 3.7-6) was covered almost equally by sand and gravel (ARCADIS 2012a).

Figure 3.7-6 Unnamed Tributary Upstream of Road Crossing

During the April 2012 survey, additional reaches within both Camp Branch Creek and Haile Gold Mine Creek were assessed (ARCADIS 2012b). For the three additional sites visited in Camp Branch Creek (the upstream portion of creek), the velocity ranged from 0.67 to 0.80 ft/sec, with depth averaging 0.50 feet. The wetted width ranged from 5.7 to 11.1 feet. In Haile Gold Mine Creek; velocity was the swiftest upstream (0.72 ft/sec) and slowest near the Ledbetter Reservoir (0.46 ft/sec). Depth followed the same pattern as velocity; the shallowest site was upstream at 0.36 foot deep, and the deepest site near Ledbetter Reservoir was 1.8 feet (Table 3.7-1).

Bottom substrates once again were evaluated in the additional reaches. Haile Gold Mine Creek upstream had a bottom of sandy silt along with gravel and coarse particulate organic matter (CPOM), which is typically greater than 1 mm and may be the result of forest organic matter. Silt was the main substrate near Ledbetter Reservoir, along with CPOM. The bottom substrate of one of the Camp Branch Creek locations (farthest upstream) was similar to Haile Gold Mine Creek in that it was mainly sandy silt with an abundance of CPOM. The remaining two Camp Branch Creek locations were similar (Figure 3.7-7), consisting mainly of gravel and sand (ARCADIS 2012b).

Figure 3.7-7 Western Fork of Camp Branch Creek near CB5-12

## Man-Made Lakes

Past mining activities have resulted in a number of man-made ponds, lakes, and pit lakes in the Project area. A total of 17.05 acres of non-jurisdictional wetlands (including sediment basins and pit lakes), not including Ledbetter Reservoir, are present in the Project area (Haile 2012). The two main pit lakes in the Project area are Ledbetter Reservoir and Snake Pit. The three other pit lakes in the Project area are West Champion Pit, Champion Pit, and Gault Pit Lake.

Ledbetter Reservoir, an impoundment on Ledbetter Creek, was created in the late 1920s and has been a long-standing feature in Haile Gold Mine. It was named after the Ledbetter Creek that ran through this region (renamed Haile Gold Mine Creek). Ledbetter Reservoir is approximately 1,700 feet long from the northeast end to the southwest end and 250 feet wide at the center and widest point. The detention structure/weir that was first constructed in the late 1920s/early 1930s on Ledbetter Creek was replaced in 1938 by an earthen dam, creating a 12-acre lake (Haile 2012).

Snake Pit, a 5-acre pit lake located just northeast of Ledbetter Reservoir, is approximately 570 feet long (from the northwest to southeast edges) and 200 feet wide at the widest point. This area was first mined in

1989 before being closed to form a shallow lake in late 2002 through 2003 (Haile 2012). The pit was backfilled with lime-amended rock from the haul road, covered with a 2-foot layer of inert organic material as contingency, and topped by 3 feet of borrow material creating a new pit bottom. Collected stormwater flows through an exit spillway and vegetated area before being released into the upper portion of Ledbetter Reservoir (Haile 2012).

Gault Pit/Lake was initially mined in 1991 before being closed to establish a small pond in 2001 (Haile 2012). This 3.5-acre lake was formed using historic boulders (from the 1940s) and contains approximately 9,000 cubic yards of lime-amended material on the pit floor. Currently, Gault Lake collects rain and stormwater but does not discharge out of the lake (Haile 2012).

Two other pits located within the Project boundary are Champion Pit and West Champion Pit. Mining began in Champion Pit during November 1989 and continued through early 1990, but the pit was not closed to form a lake until 2000 (Haile 2012). The original lake was 4 acres before being reconfigured to 5.5 acres. Overburden material was lime amended and backfilled into the pit, and 2 feet of clay was placed over the backfill to create a new bottom (Haile 2012). Precipitation currently collects in the lake, where the water is monitored regularly.

West Champion Pit is a smaller (1.7-acre) pit located just west of Champion Pit. It was originally mined from October 1990 through 1991, when it was closed to form a pond in late 1991 (Haile 2012). The area surrounding the pond is a mature forest consisting of dense trees and brush.

### Wetlands

Wetlands are located in and around Camp Branch Creek and Haile Gold Mine Creek, and act as the headwaters to the mainstem or the tributaries for each waterbody. In South Carolina, headwater wetlands are an important feature in watersheds and 1st-order streams through seepage areas or braided channels. Additional information on wetlands is in Section 3.6.

### 3.7.2.2 Biological Assemblages

The following descriptions of existing biological assemblages occurring in the aquatic habitats of the study area are based on references and on field surveys conducted between 1986 and 2012. The key surveys for aquatic resources in the study area are described below.

### Streams

#### *Fish Community and Condition*

Fish have been surveyed in Haile Gold Mine Creek, Camp Branch Creek, and the Little Lynches River beginning in 1993 (Rohde 1993). Most of the earlier surveys were conducted to determine the presence and range of the Sandhills chub (*Semotilus lumbee*) within the mining/reclamation area and along nearby sections of the Little Lynches River because of the chub's conservation priority status in South Carolina. More recent surveys attempted to classify the fish population in each waterbody in the Project area. Figure 3.7-8 shows the sampling locations for fish surveys.

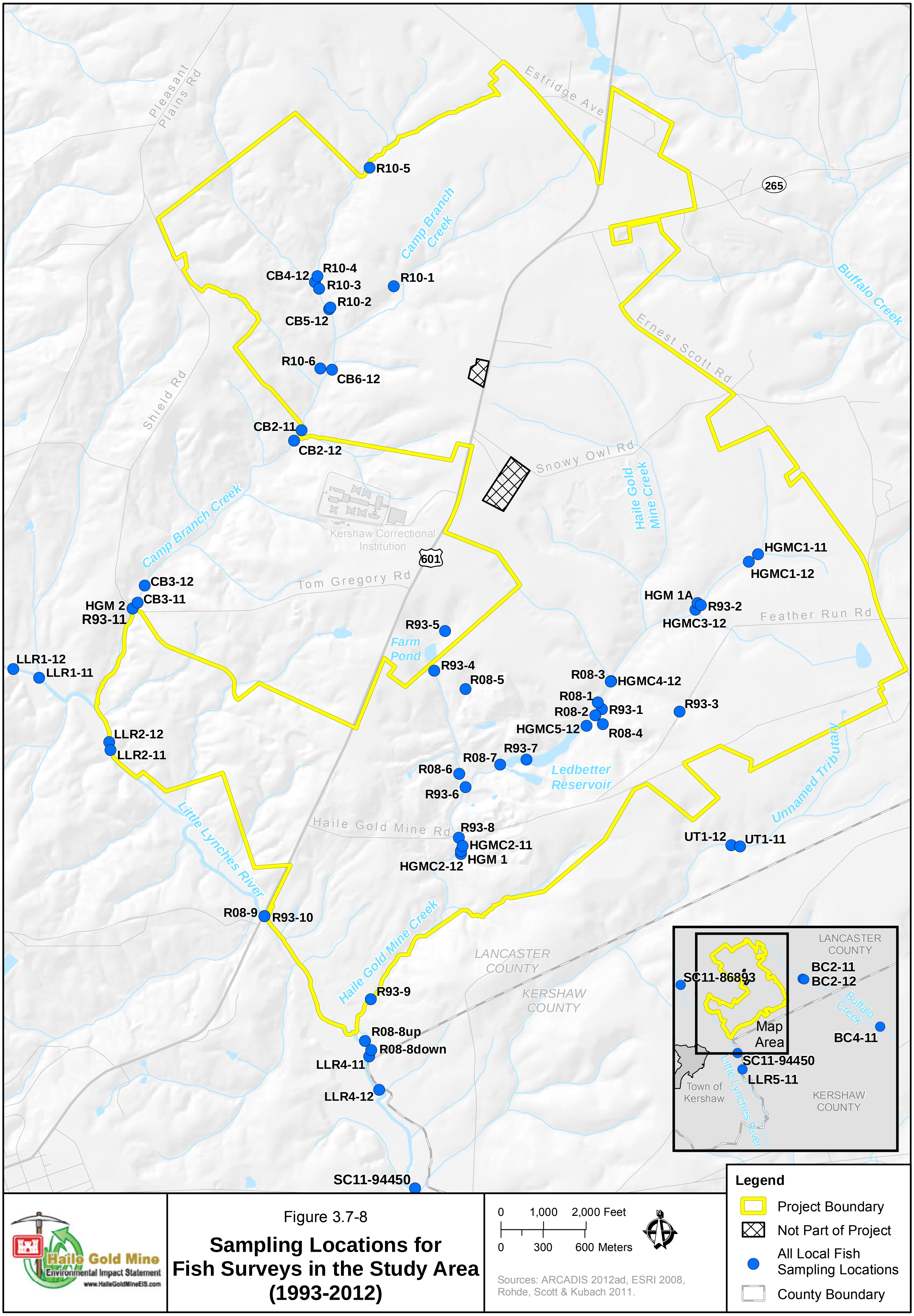



Figure 3.7-8

**Sampling Locations for Fish Surveys in the Study Area (1993-2012)**

Sources: ARCADIS 2012ad, ESRI 2008, Rohde, Scott & Kubach 2011.

As discussed in Section 3.7.1, there are three classifications for species conservation priority in South Carolina. Table 3.7-2 shows which species were observed in the study area and which species have the potential to occur. Based on a review of the individual species range maps, habitat requirements, and diet needs, only a subset of each priority category was predicted to occur in the study area. Four of the highest priority species have the potential to be found in the study area (two were observed), four of the high priority species could exist in the Lynches Basin (two were observed), and 10 of the moderate priority species could occur in the Lynches River or Upper Lynches River basins (five were observed).

Table 3.7-3 provides summary data for fish sampling events in the study area between 1993 and 2012, and Table 3.7-4 provides summary data for waterbodies surveyed in the study area between 1993 and 2012. The discussion after these tables is organized chronologically by the sampling events.

### Table 3.7-2 South Carolina Priority Fish Species Observed or with the Potential to Occur in the Study Area

| Common Name | Scientific Name | South Carolina Priority Species Conservation Status | Potential for Occurrence in the Study Area |
|---|---|---|---|
| American eel | *Anguilla rostrata* | Highest | Observed |
| Sandhills chub | *Semotilus lumbee* | Highest | Observed |
| "Broadtail" madtom | *Noturus* spp. c.f. *insignis* | Highest | Potential |
| "Thinlip" chub | *Cyprinella* spp. c.f. *zanema* | Highest | Potential |
| Greenhead shiner | *Notropis chlorocephalus* | High | Observed |
| Piedmont darter | *Percina crassa* | High | Observed |
| Quillback | *Carpiodes cyprinus* | High | Potential |
| Seagreen darter | *Etheostoma thalassinum* | High | Potential |
| Fieryblack shiner | *Cyprinella pyrrhomela* | Moderate | Observed |
| Flat bullhead | *Ameiurus platycephalus* | Moderate | Observed |
| Greenfin shiner | *Cyprinella chloristia* | Moderate | Observed |
| Mud sunfish | *Acantharchus pomotis* | Moderate | Observed |
| Snail bullhead | *Ameiurus brunneus* | Moderate | Observed |
| Highback chub | *Hybopsis hypinotus* | Moderate | Potential |
| Lowland shiner | *Pteronotropis stonei* | Moderate | Potential |
| Notchlip redhorse | *Moxostoma collapsum* | Moderate | Potential |
| Striped bass | *Morone saxatilis* | Moderate | Potential |
| White catfish | *Ameriurus catus* | Moderate | Potential |

Note: For fish species observed or with the potential to occur in the study area, 18 were classified as highest priority, 13 as high priority, and 31 as moderate priority (SCDNR 2005b).

## Table 3.7-3 Summary of Fish Data by Survey (1993–2012)

| Source of Survey Results[a] | Number of Locations Sampled | Waterbodies Surveyed | Total Number of Individuals | Total Number of Species | Species Diversity[b] |
|---|---|---|---|---|---|
| Rohde (1993) | 11 | Haile Gold Mine Creek, Little Lynches River, Camp Branch Creek, Ledbetter Reservoir, and Farm Pond | 506 | 23 | 3.45 |
| Rohde (2008) | 10 | Haile Gold Mine Creek and Little Lynches River | 515 | 20 | 2.85 |
| Rohde (2010) | 6 | Camp Branch Creek | Unknown | 13 | -- |
| SCDNR (2011) | 5 | Haile Gold Mine Creek and Little Lynches River | 1,299 | 29 | 2.931 |
| ARCADIS (2012a)[c] | 11 | Haile Gold Mine Creek, Little Lynches River, Camp Branch Creek, Buffalo Creek, and Unnamed Tributary | 5,355 | 35 | 3.532 |
| ARCADIS (2012b)[d] | 6 | Little Lynches River, Camp Branch Creek, Haile Gold Mine Creek, and Champion Branch Creek | 718 | 21 | 2.81 |
| ARCADIS (2012b) | 15 | Haile Gold Mine Creek, Little Lynches River, Camp Branch Creek, Buffalo Creek, and Unnamed Tributary | 2,483 | 28 | 3.179 |

a The year of the source reference represents the year in which sampling was conducted, except as noted for ARCADIS (2012a).

b Source: Staff analysis – species diversity was calculated by sampling event for all the collected data, using the Shannon-Wiener diversity index. Species *diversity* reflects total number of species and species evenness (how equal the abundances of the species are). The Shannon-Wiener index is based on information theory and attempts to measure the amount of order within a system (Krebs 1999). The diversity measure, or Shannon's H, increases as the uncertainty in predicting what taxa drawn at random from a collection of taxa or individuals increases (Ludwig and Reynolds 1998).

c Sampling surveys were conducted in 2011.

d This represents the results of the migratory fish surveys that were conducted separate from the annual fish community surveys.

### Table 3.7-4 Summary of Fish Data by Waterbody (1993–2012)

| Waterbody Surveyed | Years Surveyed | Number of Locations | Total Number of Individuals | Total Number of Species | Species Diversity[a] |
|---|---|---|---|---|---|
| Haile Gold Mine Creek | 1993, 2008, 2011, 2012 | 23 | 631 | 9 | 1.292 |
| Camp Branch Creek | 1993, 2010, 2011, 2012 | 16 | 2,265 | 16 | 3.095 |
| Little Lynches River | 1993, 2008, 2011, 2012 | 17 | 6,985 | 41 | 3.064 |
| Unnamed Tributary | 2011, 2012 | 2 | 182 | 2 | 0.233 |
| Champion Branch Creek | 2012 | 1 | 0 | 0 | 0 |
| Buffalo Creek | 2011, 2012 | 3 | 1,106 | 16 | 1.722 |
| Farm Pond | 1993 | 1 | 29 | 4 | 1.376 |
| Ledbetter Reservoir | 1993 | 1 | 4 | 2 | N/A |
| **Overall total** | | **64** | **11,202** | **45** | **3.695** |

[a] Source: Staff analysis – species diversity was calculated by sampling event for all the collected data, using the Shannon-Wiener diversity index. *Species diversity* reflects the total number of species and species evenness (how equal the abundances of the species are). The Shannon-Wiener index is based on information theory and attempts to measure the amount of order within a system (Krebs 1999). The diversity measure, or Shannon's H, increases as the uncertainty in predicting what taxa drawn at random from a collection of taxa or individuals increases (Ludwig and Reynolds 1998).

In 1993, Rohde sampled at 11 different locations to determine the presence of the Sandhills chub. Six of the sampling locations were in Haile Gold Mine Creek (R93-1, R93-2, R93-3, R93-4, R93-6, and R93-8), two locations were in the Little Lynches River (R93-9 and R93-10), and one location was in Camp Branch Creek (R93-11) (Figure 3.7-8). Fish were collected at seven of the 11 locations, and the Sandhills chub was collected only from Haile Gold Mine Creek. Four of the other conservation priority-designated species (fiery black shiner, flat bullhead, mud sunfish, and piedmont darter) also were collected. During this survey, 506 fish were collected, representing 23 different species. Sampling methods included seine scoops or seine hauls using a 10-foot by 4-foot by 1/8-inch mesh nylon flat seine.

Fish were sampled again in 2008 to determine the range of the Sandhills chub in the Project area (Rohde 2008). Ten locations were surveyed: three locations in the Little Lynches River (R08-8 down, R08-8 up, and R08-9) and the remaining seven in Haile Gold Mine Creek (R08-1 to R08-7) (Figure 3.7-8). A similar number of species (20) and individuals (515) were collected in 2008; the Sandhills chub was found only in Haile Gold Mine Creek. The fieryblack shiner, mud sunfish, and piedmont darter also were collected within the various reaches. Fish were collected in the Little Lynches River with a 10-foot by 4-foot by 1/4-inch mesh seine net in a few seine hauls. A large, fine-meshed dip net mainly was used to collect fish in Haile Gold Mine Creek, except for the two locations upstream of Ledbetter Reservoir where a dip net along with a seine net (three seine hauls) were used to collect specimens.

In 2010, Rohde sampled six locations within the Camp Branch Creek system (Figure 3.7-8) to determine the presence of the Sandhills chub (Rohde 2010). A large, fine-meshed dip net was used at all locations to collect samples, with two short kick sets (fish flushed from the substrate by kicking into the dip net) completed at one location and with seine hauls with a 10-foot by 4-foot by 1/4-inch seine at the more downstream portion of Camp Branch Creek. Because quantitative values were not reported at two locations, an overall number of fish collected is not possible. The total number of species collected in Camp Branch Creek was 13. The Sandhills chub was observed at three of the six locations, in both upper and lower sections in Camp Branch Creek. The only other South Carolina priority species collected, the greenhead shiner, was found at R10-6. The SCDNR completed a comprehensive survey of Haile Gold Mine Creek and associated streams in March 2011 (Scott et al. 2011). Field staff sampled at five different locations following the South Carolina Stream Assessment Standard Operating Procedures. Two of the locations were in Haile Gold Mine Creek (HGM 1 and HGM 1A), one location was in Camp Branch Creek (HGM 2), and two locations were in the Little Lynches River upstream (86893) and downstream (94450) of the Project area (Figure 3.7-8). Within these five reaches, 1,299 individuals were caught, representing 29 different species. The Sandhills chub was collected only in the upper portion of Haile Gold Mine Creek. Other South Carolina priority species collected during this survey were found in the Little Lynches River (greenfin shiner, snail bullhead, flat bullhead, and piedmont darter) and Camp Branch Creek (greenhead shiner).

As part of the *Comprehensive Baseline Wildlife and Aquatic Resources Report* for the Haile Gold Mine, five waterbodies were sampled in October 2011 to determine what species were present in the various systems (ARCADIS 2012a). Sampling occurred in Haile Gold Mine Creek, Camp Branch Creek, an Unnamed Tributary, Buffalo Creek, and the Little Lynches River (Figure 3.7-8). Fish were collected via backpack electrofishing with the aid of block nets or seine nets. Depending on the size of the reach, one to three backpack units were used in a single survey pass; in Buffalo Creek, three survey passes were made by two backpack electrofishing teams. During this study, 5,355 individuals were collected, representing 35 different species. The highest number of species was collected in the Little Lynches River compared to the other waterbodies (Table 3.7-3). Unlike previous sampling events, the Sandhills chub was not found in Haile Gold Mine Creek; instead, it was collected in the Unknown Tributary and in both Buffalo Creek locations. South Carolina species with a high priority status, the greenhead shiner and piedmont darter, were collected from Camp Branch Creek and one location in the Little Lynches River (LLR5-11). Species with a medium priority such as the greenfin shiner were collected in Little Lynches River both upstream and downstream of the Project boundary and in Camp Branch Creek at Tom Gregory Road. The flat bullhead was collected in the upstream portion of the Little Lynches River, and the mud sunfish was collected only from Buffalo Creek.

A follow-up survey for aquatic resources was conducted in spring 2012 according to the study plan (ARCADIS 2012d). Most of the same stream reaches that were sampled in October 2011 were revisited, in addition to three new locations in both Haile Gold Mine Creek and Camp Branch Creek (ARCADIS 2012b). A total of 15 locations were surveyed in April 2012. Three of the locations were located in the Little Lynches River, five locations were in Haile Gold Mine Creek, five locations were in Camp Branch Creek, one location was in Buffalo Creek, and one location was in the Unnamed Tributary (Figure 3.7-8). A total of 2,483 individuals were captured during this survey, representing 28 species. No fish were collected from the uppermost sampling location in Haile Gold Mine Creek during April 2012 (as was the case in fall 2011). The Sandhills chub was found in the greatest abundance in Haile Gold Mine Creek, but individuals also were collected from Buffalo Creek and the Unnamed Tributary. Five other priority species were collected: the greenfin shiner, greenhead shiner, flat bullhead, mud sunfish, and Piedmont darter (Appendix L).

In addition to the spring survey for local species, a migratory fish study took place over two separate 3-day sampling periods in March and April 2012 (ARCADIS 2012b). The objective of the surveys was to characterize the baseline presence or absence of diadromous fish species in the Little Lynches River (ARCADIS 2012c). Figure 3.7-9 shows the sampling locations for the study.

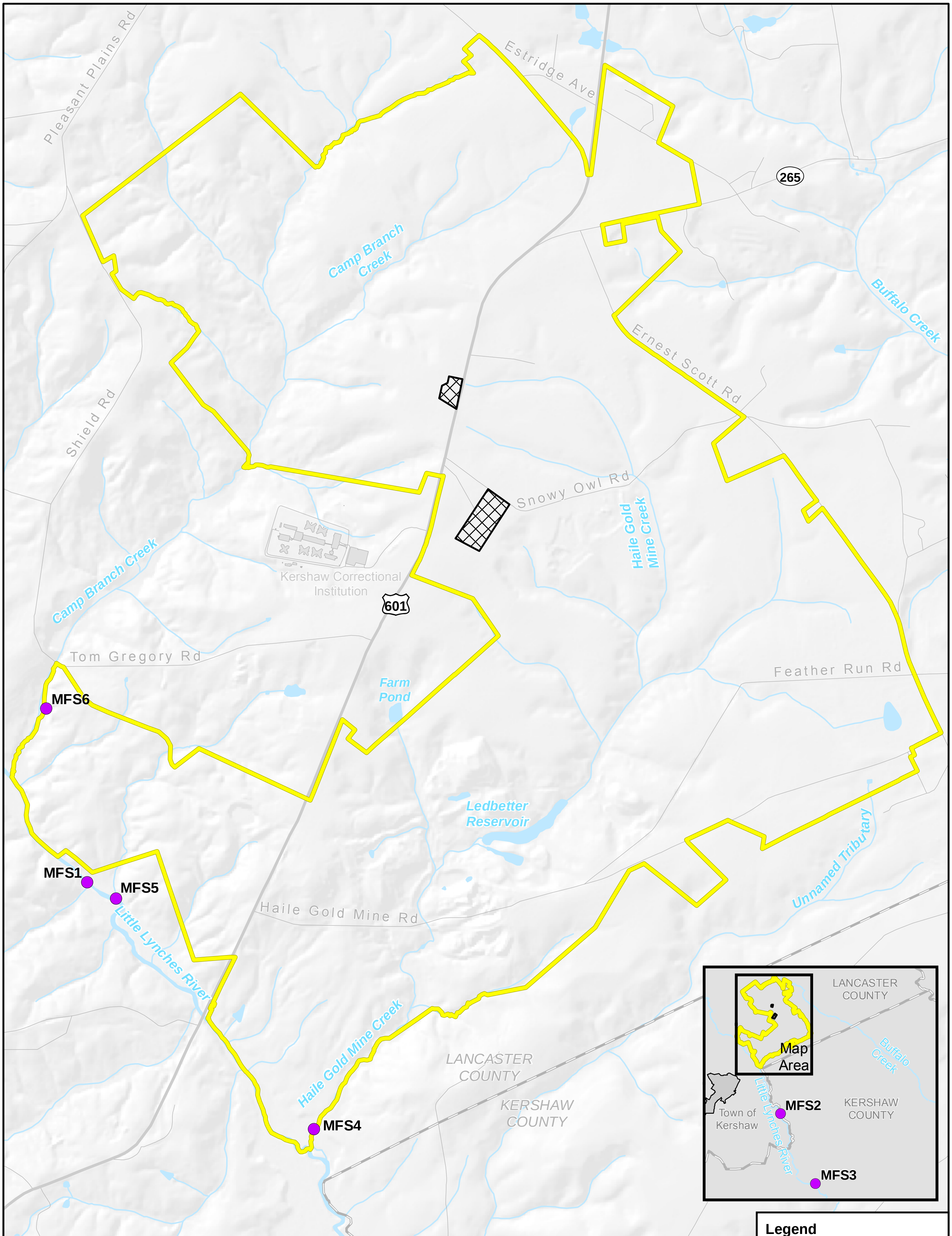



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Figure 3.7-9

**Sampling Locations for 2012 Migratory Fish Study**

0 1,000 2,000 Feet
0 300 600 Meters

Sources: ARCADIS 2012d, ESRI 2008.

**Legend**

- Project Boundary
- Not Part of Project
- 2012 Migratory Fish Sampling Locations
- County Boundary

Three different collection methods were used for each of the sampling locations in the Little Lynches River (MFS1–MFS3) to potentially collect migratory species. A fyke net (trap) and 10 eel pots (traps) were deployed overnight for three consecutive nights at all Little Lynches River sites, followed by electrofishing once daily. During the first survey event, an American eel (*Anguilla rostrata*) was observed in the Little Lynches River. Following this discovery, three additional locations for electrofishing only were added to tributary streams, including Haile Gold Mine Creek (MFS4), Champion Branch Creek (MFS5), and Camp Branch Creek (MFS6).

No local or migratory species were collected in the tributary streams, and only the catadromous (fish spawning in saltwater) American eel was collected in the Little Lynches River. Seven American eels (two at the most upstream location and five at the most downstream location) were collected via electrofishing; their lengths ranged from 8.7 to 20.1 inches. No other anadromous (fish spawning in freshwater) or catadromous fish species was observed. However, three priority species (greenfin shiner, greenhead shiner, and flat bullhead) were observed in the Little Lynches River (ARCADIS 2012b) (Appendix L). A total of 718 fish were collected via the three sampling methods, representing 21 species.).

The American eel is considered a species with highest conservation priority status in South Carolina (SCDNR 2005a). The species was petitioned in 2004 to be listed as a threatened or endangered species under the ESA, and again in 2010 to be listed as a threatened species (USFWS 2005, 2011). Both petitions warranted a 90-day administrative finding, and a 12-month finding followed the 2004 petition (USFWS 2005). As a result of the 12-month finding, the American eel was not listed as threatened or endangered (USFWS 2007). Currently, the American eel is undergoing a status review by the USFWS to determine whether listing the species under the ESA is warranted (USFWS 2011).

Figure 3.7-10 illustrates the number of species observed by survey, for surveys conducted in the study area between 1993 and 2012. Figure 3.7-11 illustrates the number of fish species observed by waterbody, for the same surveys in the study area. As shown in Figure 3.7-10 and Table 3.7-2, the total number of species observed by sampling event was fairly even across all events. The survey with the greatest number of species observed (35) was the ARCADIS October 2011 survey (ARCADIS 2012a). When number of species observed was compared by waterbody, the Little Lynches River had the greatest number of species (Table 3.7-3 and Figure 3.7-11). Camp Branch Creek and Buffalo Creek had the same number of species observed (16); Farm Pond, Ledbetter Reservoir, the Unnamed Tributary, and Champion Branch Creek had very few or no species observed (Table 3.7-3).

Figure 3.7-12 illustrates fish species diversity by sampling event, for surveys conducted in the study area between 1993 and 2012. Figure 3.7-13 illustrates fish species diversity by waterbody for the same surveys in the study area. *Species diversity* reflects the total number of species and species evenness (how equal the abundances of the species are). Species diversity was calculated by sampling event and waterbody for all the collected data, using the Shannon-Wiener diversity index.

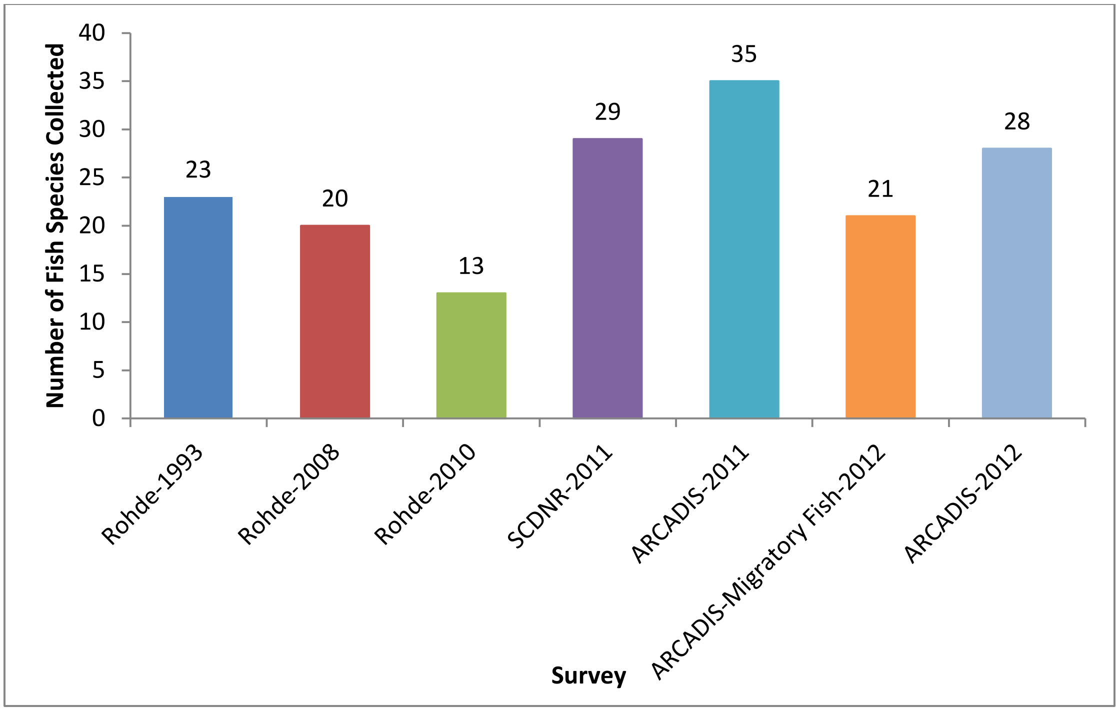


Figure 3.7-10 Number of Fish Species by Survey (1993–2012)

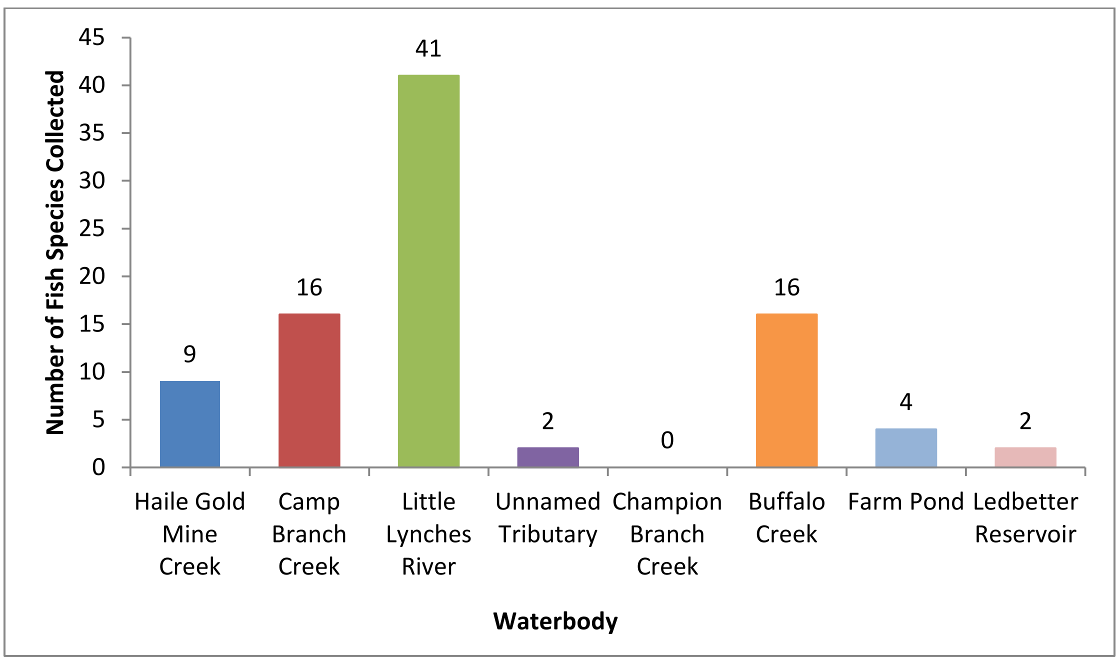


Figure 3.7-11 Number of Fish Species by Waterbody (1993–2012)

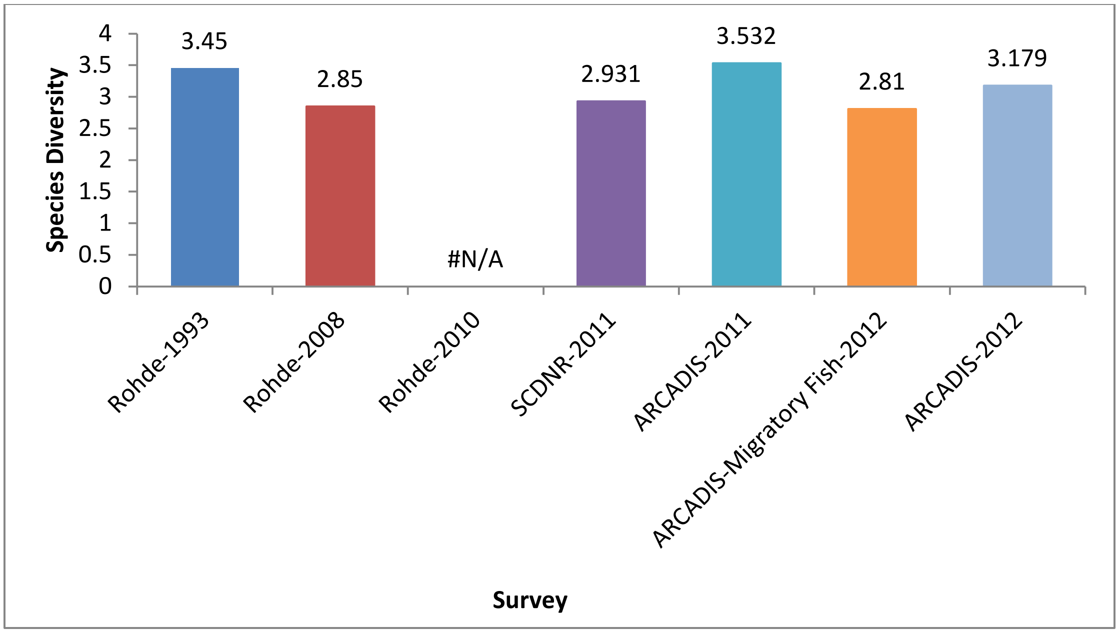


Figure 3.7-12 Fish Species Diversity by Survey (1993–2012)

Note: Species diversity was calculated by sampling event for all the collected data, using the Shannon-Wiener diversity index.

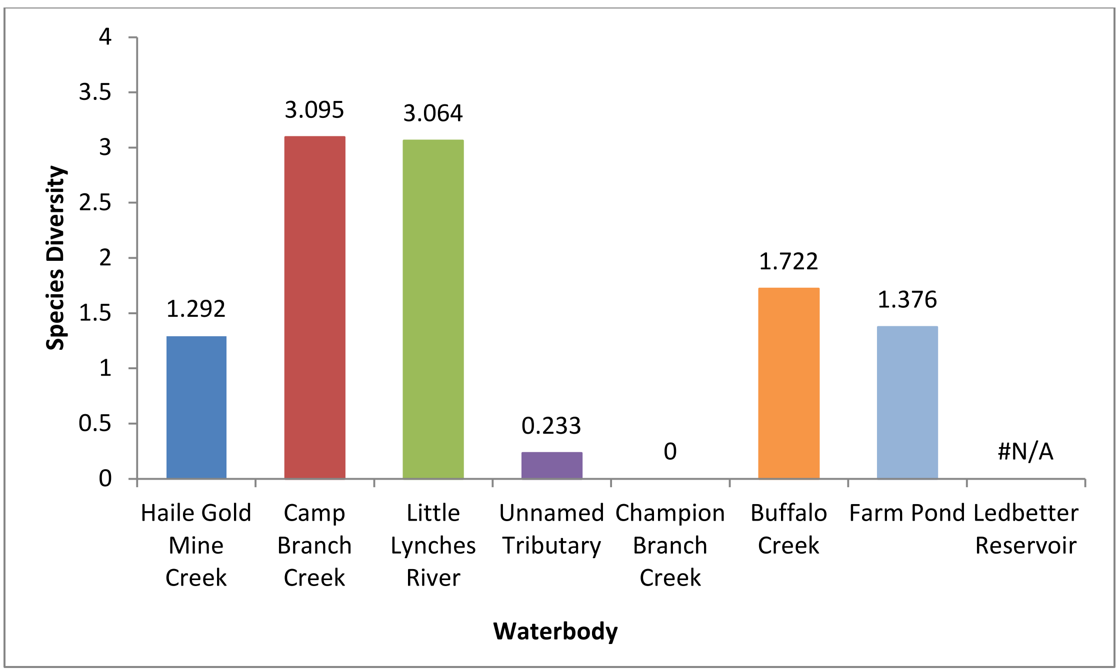


Figure 3.7-13 Fish Species Diversity by Waterbody (1993–2012)

Note: Species diversity was calculated by waterbody for all the collected data, using the Shannon-Wiener diversity index.

As shown in Figure 3.7-12 and Table 3.7-3, the species diversity when compared by sampling event was fairly even across all events. Diversity could not be calculated for the Rohde 2010 survey because the actual number of individuals captured by for each species was not available. The survey with the highest overall diversity was the ARCADIS October 2011 survey (ARCADIS 2012a). When species diversity was calculated by waterbody, Camp Branch Creek and the Little Lynches River had the highest diversity (Table 3.7-4 and Figure 3.7-13). The lower diversity observed in the Unnamed Tributary, Haile Gold Mine Creek, and Farm Pond is partially due to the low number of species yet relatively high number of individuals collected (Table 3.7-4).

Seven different surveys were conducted within the study area between 1993 and 2012 (Tables 3.7-3 and 3.7-4). Combining all the surveys, 64 locations were sampled, with some overlap over time (Figures 3.7-8 and 3.7-9). Fish were collected at 51 of the stations, representing 45 different species (Table 3.7-4). Most of the fish species observed were insectivores; few omnivores and predator species present. The waterbody with the highest number of observed species (41) was the Little Lynches River while the Unnamed Tributary had the lowest number of observed species (2), as shown in Figure 3.7-11. See Appendix L for additional information.

### *Sandhills Chub (Semotilus lumbee)*

The Sandhills chub is a small-bodied fish species in the minnow family (Figure 3.7-14) with a restricted range of occurrence linked to the Sandhills ecoregion, but within which it is fairly abundant in its preferred headwater habitat.


Figure 3.7-14 Sandhills Chub

Source: SCDNR 2005a.

The general range of this species encompasses the headwaters of Coastal Plain streams of north-central South Carolina and south-central North Carolina including the Cape Fear River, Little Pee Dee River, and Pee Dee River drainages (Snelson and Suttkus 1978). The fish was found by Rohde and Arndt (1991) at 15 of the 26 previously known locations—in addition to 38 new locations. In 1991, Rohde and Arndt extended the range northward to three sites in the Deep River (North Carolina) and four locations in the Lynches and Wateree Rivers of South Carolina (Figure 3.7-15).

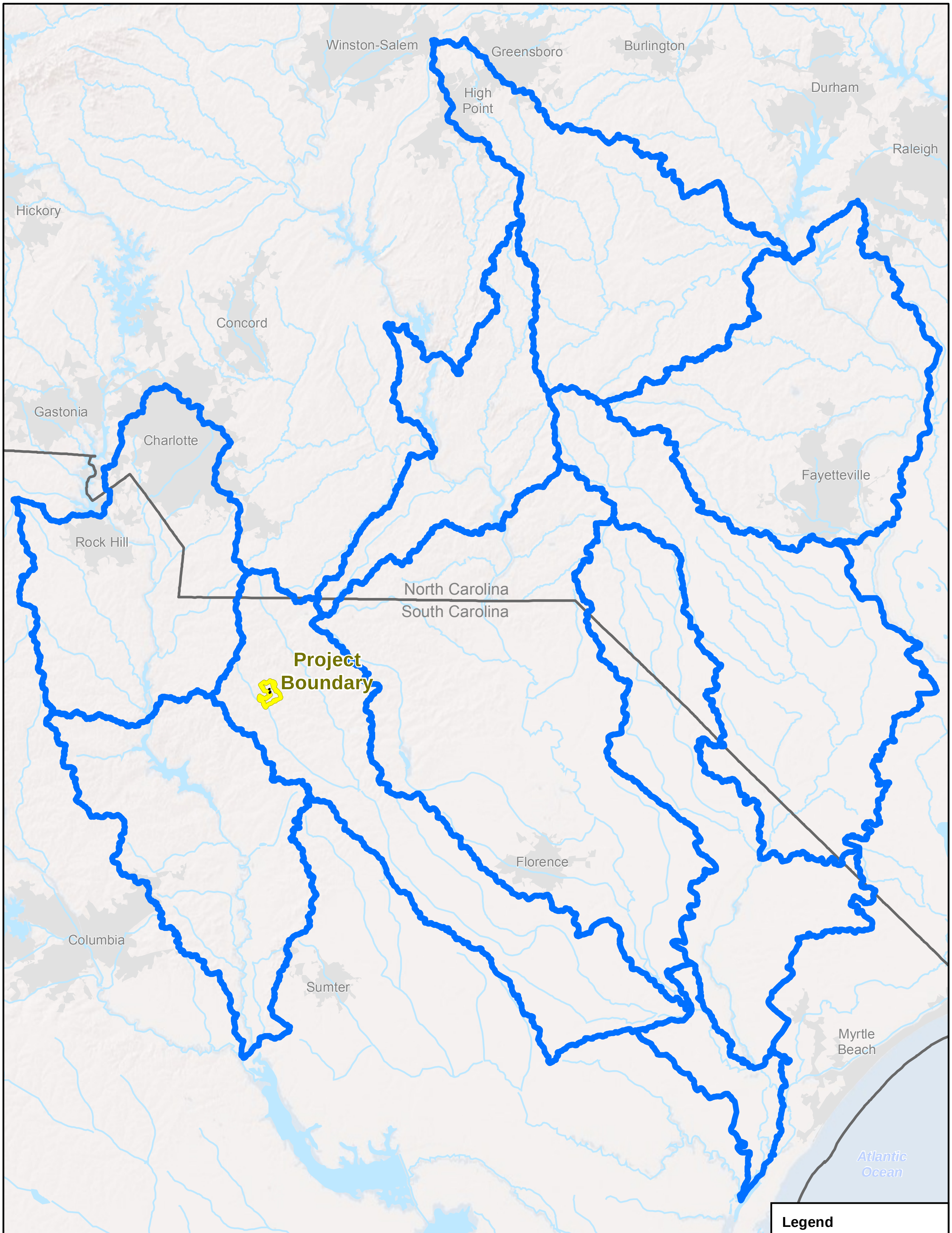


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Figure 3.7-15

**Current Range of Sandhills Chub**

### *Distribution in the Study Area*

In the aquatic resources study area, the Sandhills chub was found in Camp Branch Creek, the Unnamed Tributary (southeast of the Project Area), Buffalo Creek, and Haile Gold Mine Creek (Table 3.7-5) but not in the Little Lynches River. The upper portions of these three systems lie within the Southeastern Plains-Sandhills region and are narrow headwater streams, which is the habitat of choice for the Sandhills chub (Rohde and Arndt 1991). In the Project area, the lowest number of species (nine) were observed in Haile Gold Mine Creek; however, the highest number of Sandhills chub were observed there. Table 3.7-5 and Figure 3.7-16 show the composition of Sandhills chub by waterbody.

### *Habitat and Ecology*

The Sandhills chub prefers clear, cool, medium-current streams, a sand/gravel substrate, and no or little vegetation. It is most abundant in narrow (1.2 to 2.4 m wide) and shallow (0.15 to 0.38 m deep) 1st-order headwater streams where it is the dominant, and sometimes the only, fish present (Rohde and Arndt 1991). During the surveys from 1989 to 1991, Sandhills chub were found in streams with velocities between 0.02 and 0.67 m/sec, were commonly found with pirate perch (*Aphredoderus sayanus*) and dusky shiner (*Notropis cummingsae*), and preferred areas with no submerged vegetation (Rohde and Arndt 1991).

Based on tolerance and trophic guild classifications, the Sandhills chub is considered to be an intolerant, insectivorous species (NCDENR 2001). Sandhills chub construct pit-ridge nests in the gravel reaches of 1st- and 2nd-order streams in tails of pools midstream or along the banks, using undercut banks as refuge (Woolcott and Maurakis 1988). The males protect the nest, which is continually shaped and excavated by the streamflow, but have no known nest associates (Woolcott and Maurakis 1988). Woolcott and Maurakis (1988) found that males spawned during the day at minimum water temperatures of 13.9°C and 17.0°C.

**Table 3.7-5 Composition of Sandhills Chub by Waterbody (1993–2012)**

| Waterbody Surveyed | Number of Sampling Locations | Number of Sandhills Chub Collected | Number of Individual Fish Collected | Percentage of Sandhills Chub in the Total Number of Fish Collected |
|---|---|---|---|---|
| Haile Gold Mine Creek | 23 | 367 | 631 | 58% |
| Camp Branch Creek | 16 | 91 | 2,265 | 4% |
| Little Lynches River | 17 | 0 | 6,985 | 0% |
| Unnamed Tributary | 2 | 174 | 182 | 96% |
| Buffalo Creek | 3 | 68 | 1,106 | 6% |
| Champion Branch Creek | 1 | 0 | 0 | 0% |
| Farm Pond | 1 | 0 | 29 | 0% |
| Ledbetter Reservoir | 1 | 0 | 4 | 0% |
| **Overall total** | **64** | **700** | **11,202** | **6%** |

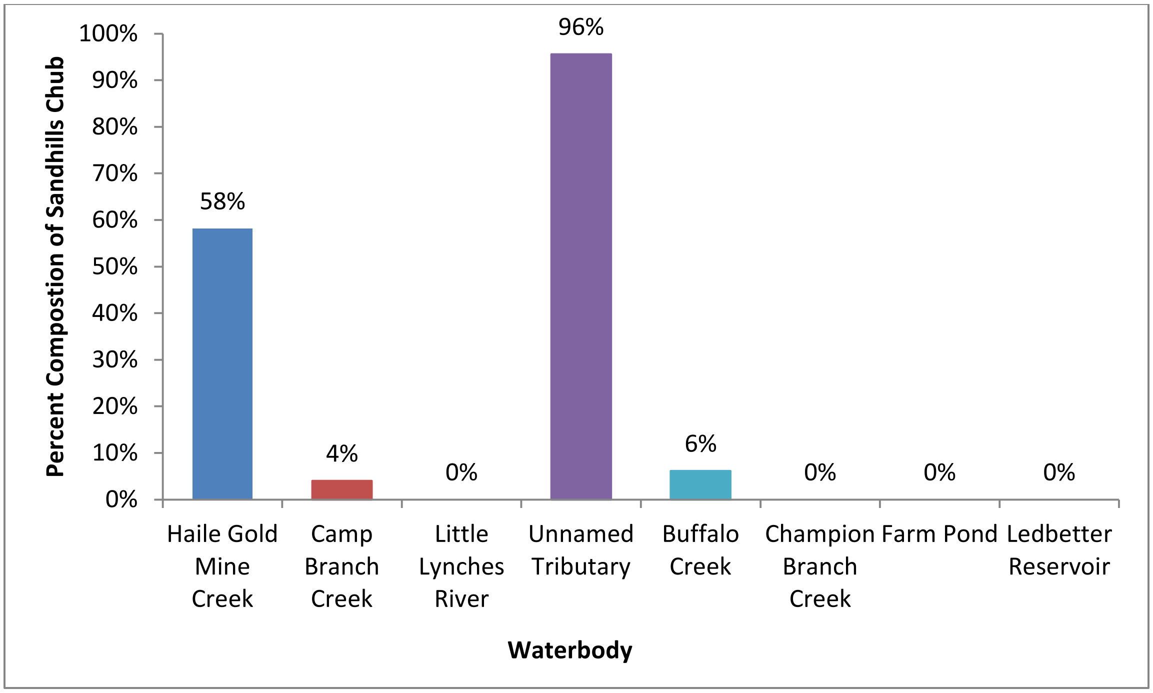


Figure 3.7-16 Composition of Sandhills Chub by Waterbody (1993–2012)

### *Status and Threats*

The Sandhills chub global status was last reviewed on August 2, 2012, when it was given a Global Status of G3G4 (G3-Vulnerable, G4-Aparently Secure) as it is fairly common in a small range in Carolina streams where development is occurring but is currently stable (NatureServe 2012). It has a similar National Status of N3N4 (N3-Vulnerable, N4-Apparently Secure); and its state status in South Carolina is S2, or imperiled (NatureServe 2012). In 1991, the Sandhills chub was proposed to be added to the list of protected species in South Carolina; however, it was found to be more abundant than previously believed (USFWS 1991). It is still considered a South Carolina priority species, with a designation of highest conservation priority (SCDNR 2005a).

Current threats to the species are beavers or human activities that would impound streams (Rohde and Arndt 1991). Dams or other impoundments can change habitat from flowing to stagnant, reduce current, increase water temperature, and soften the bottom substrate (Rohde and Arndt 1991). Rohde and Arndt did not find the currently established populations in jeopardy at the time of their surveys. Currently, this species is of relatively low conservation concern and does not require significant additional protection or major management, monitoring, or research actions (IUCN 2014).

### *Benthic Macroinvertebrates*

Beginning in 1987 and continuing through the present, macroinvertebrates have been sampled in Haile Gold Mine Creek both upstream and downstream of Ledbetter Reservoir (Enwright Laboratories 1988a, 1988b, 1988, 1989, 1990). Starting in 1990, sampling locations were added to the Little Lynches River, upstream (at US 601) and downstream (below the confluence) of Haile Gold Mine Creek (Figure 3.7-17). These sampling events were conducted during spring, usually in April, in accordance with the NPDES permit (No. SC0040479) and followed SCDHEC protocols (SCDHEC 1998). The purpose of the annual sampling event was to monitor the macroinvertebrate communities and determine the ecological condition of the streams and the potential effects of current activities (ETT assessments from 1991 through 2011). To evaluate the ecological condition, a series of metrics were used for each sampling location to evaluate species presence, tolerance to organic pollution, and different feeding strategies.

The following eight metrics were used to evaluate each sampling event:

- Taxa richness – total number of species collected;
- Ephemeroptera/Plecoptera/Trichoptera (EPT) Index – the total number of species within the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), which are generally more sensitive to pollution;
- Biotic Index (BI) – calculated by multiplying the pollution tolerance rating for the species by the number of organisms for that species, and then dividing by the total number of organisms;
- Ratio of EPT and Chironomidae (midges) abundances – ratio of EPT species to midges;
- Percent contribution by dominant taxon – percent of the sample dominated by a single invertebrate genus or species;
- Community loss index (similarity) – used to compare different locations to a reference or control location;
- Ratios of scrapers (species that graze on periphyton from surfaces) to collector-filterers (species that strain fine particulate organic matter from the water column) – ratio of macroinvertebrates based on their different feeding strategies; and
- Ratio of shredders (species that consume CPOM originating in the riparian zone) to total number of organisms collected – ratio of macroinvertebrate species with a feeding strategy that can be affected by toxicants to total number of organisms collected.

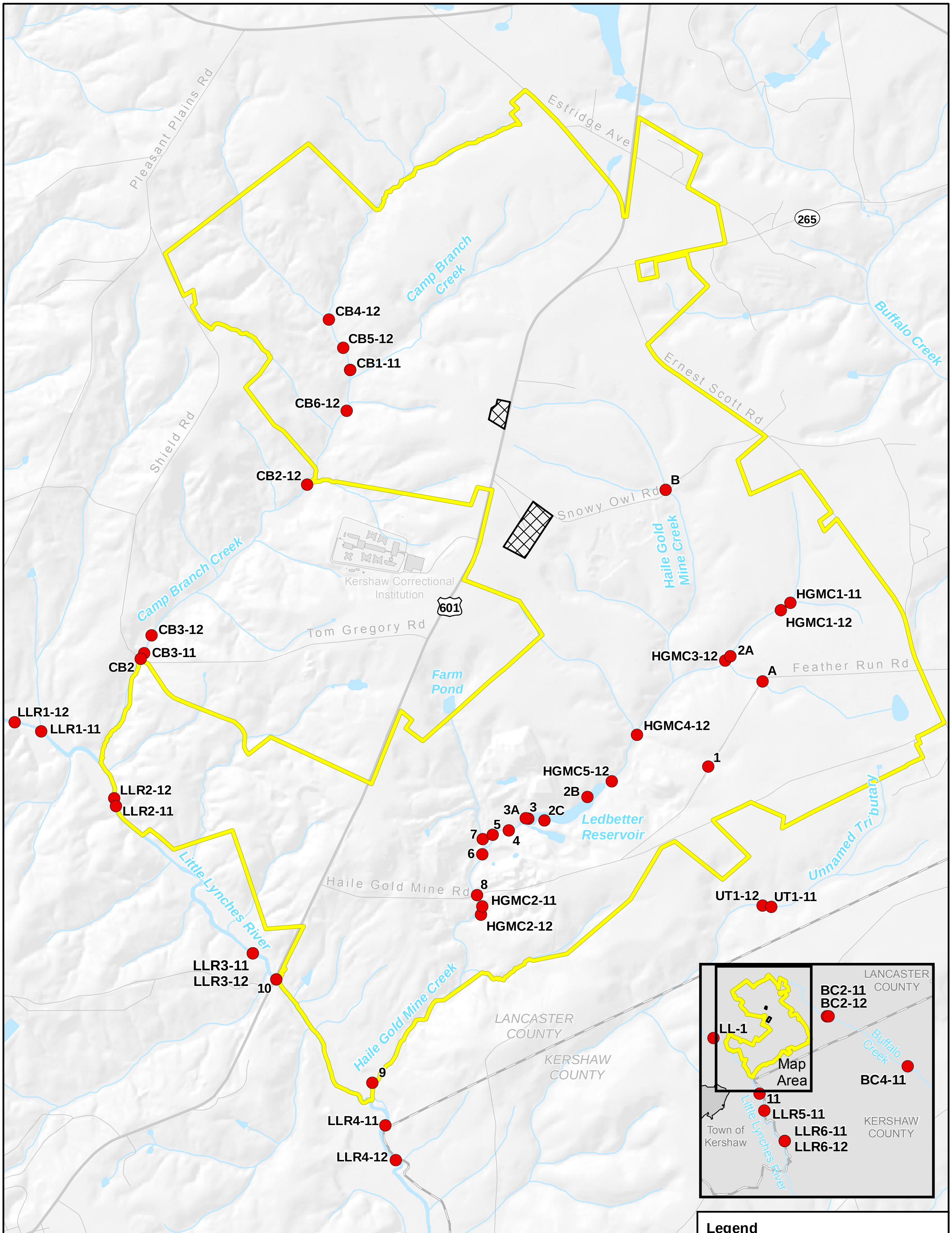


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Figure 3.7-17
**Sampling Locations for Benthic Macroinvertebrate Surveys in the Study Area (1987 to present)**

0 1,000 2,000 Feet
0 300 600 Meters

Sources: ARCADIS 2012ad, ESRI 2008, ETT 2011.

**Legend**
Project Boundary
Not Part of Project
All Benthic Macroinvertebrate Sampling Locations
County Boundary

The EPT Index and BI values were then used to determine an EPT and BI score, which varies depending on the ecoregion where sampling occurred (Piedmont, Sandhills/Coastal Plain). The EPT and BI values were averaged to obtain a mean score, which represents the independent bioclassification (categorizing organisms into groups) rating (range from 1 to 5). Scores greater than 4.5 rated “excellent,” between 3.5 and 4.4 rated “good,” between 2.5 and 3.4 rated “good-fair,” between 1.5 and 2.4 rated “fair,” and below 1.4 rated “poor” (NCDENR 2011).

These bioclassification scores then were used to determine the waterbody’s ability for aquatic life use support (ALUS). The criteria were divided into three categories based on provisions in Section 303b of the CWA: fully supporting, partially supporting, and not supporting (Table 3.7-6). Bioclassifications of excellent or good are considered “fully supporting,” good-fair and fair are considered “partially supporting,” and poor does “not support” aquatic life (NCDENR 2011).

### Table 3.7-6 Description of ALUS Classifications and Relationship to Bioclassification Scores

| Bioclassification Score | ALUS Classification | Description |
|---|---|---|
| Excellent or good | Fully supporting | Has functioning, sustainable biological assemblages (fish, macroinvertebrates, or algae) that have not been modified beyond the reference condition range. |
| Good-fair or fair | Partially supporting | Exhibits moderate modification of the biological community for at least one assemblage. |
| Poor | Does not support | Has at least one severely affected assemblage that indicates severe modification compared to the reference condition. |

Note: ALUS = aquatic life use support

Table 3.7-7 shows the number of sampling locations, number of samples, and bioclassification score for each sample for all waterbodies in the study area that were surveyed from 1990 through 2012.

Figure 3.7-18 illustrates the total number of samples within each bioclassification category from the 277 total samples taken in the study area from 1990 to 2012. Figure 3.7-19 presents the number of samples in each bioclassification category by waterbody for samples taken in the study area from 1990 to 2012.

The Buffalo Creek locations outside the Project boundary were “good-fair” and “good,” which indicate that the system could partially to fully support aquatic life. The upstream section (BC2-11) had a slightly lower EPT score, which reduced the ALUS rank. A second sampling event conducted in spring 2012 (ARCADIS 2012c) showed similar ecological health, with an overall classification of “good,” meaning that it could fully support aquatic life (Table 3.7-7). The bioclassification of the Unnamed Tributary, sampled only in spring 2012, was “good,” meaning that it also could fully support aquatic life (Table 3.7-7 and Figure 3.7-18).

### Table 3.7-7 Summary of Bioclassification Scores by Waterbody (1990–2012)

| Waterbody Surveyed | Years Surveyed | Bioclassification Score | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Number of Sampling Locations | Number of Samples | Poor | Fair | Good-Fair | Good | Excellent |
| Haile Gold Mine Creek upstream | 1990 through Spring 2012 | 5 | 28 | 1 | 6 | 16 | 5 | 0 |
| Ledbetter Reservoir | 1990 through Spring 2011 | 3 | 65 | 28 | 36 | 1 | 0 | 0 |
| Haile Gold Mine Creek downstream | 1990 through Spring 2012 | 6 | 115 | 24 | 58 | 32 | 1 | 0 |
| Camp Branch Creek | Spring 2011, Fall 2011, and Spring 2012 | 6 | 9 | 0 | 1 | 5 | 3 | 0 |
| Little Lynches River | 1990 through Spring 2012 | 7 | 56 | 1 | 9 | 31 | 15 | 0 |
| Unnamed Tributary | Spring 2012 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| Buffalo Creek | Fall 2011 and Spring 2012 | 2 | 3 | 0 | 0 | 1 | 2 | 0 |
| **Overall total** | | **30** | **277** | **54** | **110** | **86** | **27** | 0 |

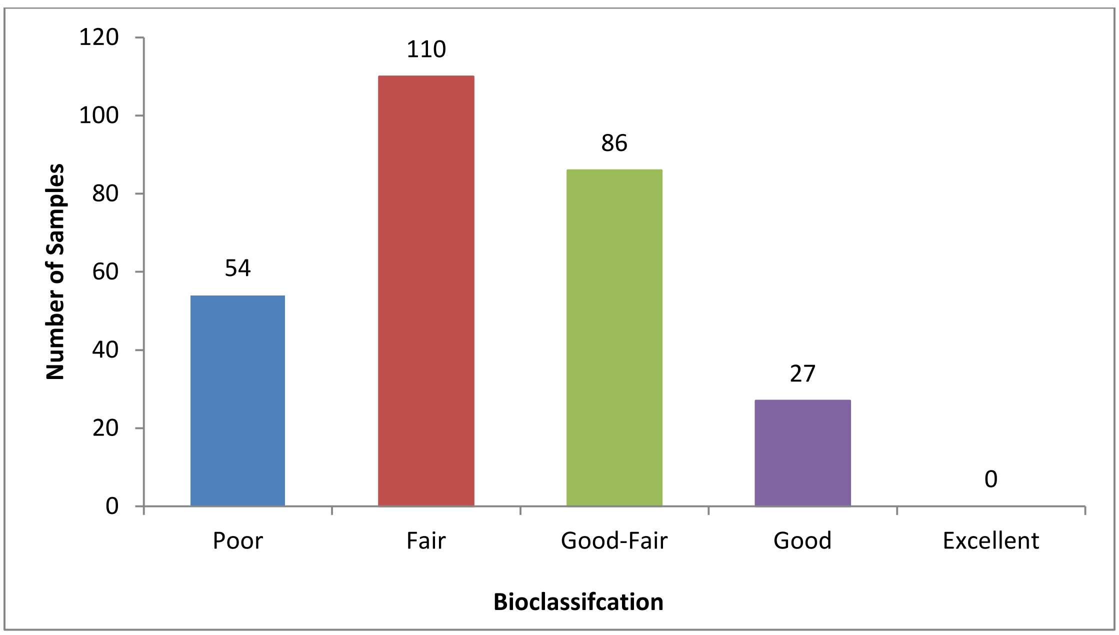


Figure 3.7-18 Total Number of Samples in Each Bioclassification Category (1990–2012)

Because Camp Branch Creek was first sampled in 2011, it has only a few representative samples and associated scores. In the 2011 ETT spring survey, the bioclassification score for the more upstream station was "good-fair," meaning it could partially support aquatic life, while classification for the more downstream location was "good," indicating that it could fully support aquatic life. Similar results were obtained during the fall 2011 sampling as part of the aquatic resources survey (ARCADIS 2012a) at both Camp Branch Creek reaches. The upstream location was classified as partially supporting and the downstream location classified as fully supporting aquatic life (Table 3.7-7). During the spring 2012 survey, five locations in Camp Branch Creek were sampled. Their bioclassification ranged from "fair" to "good," indicating that they could partially to fully support aquatic life (ARCADIS 2012b). There was no definitive pattern of distribution of the ratings between the 2011 and 2012 surveys.

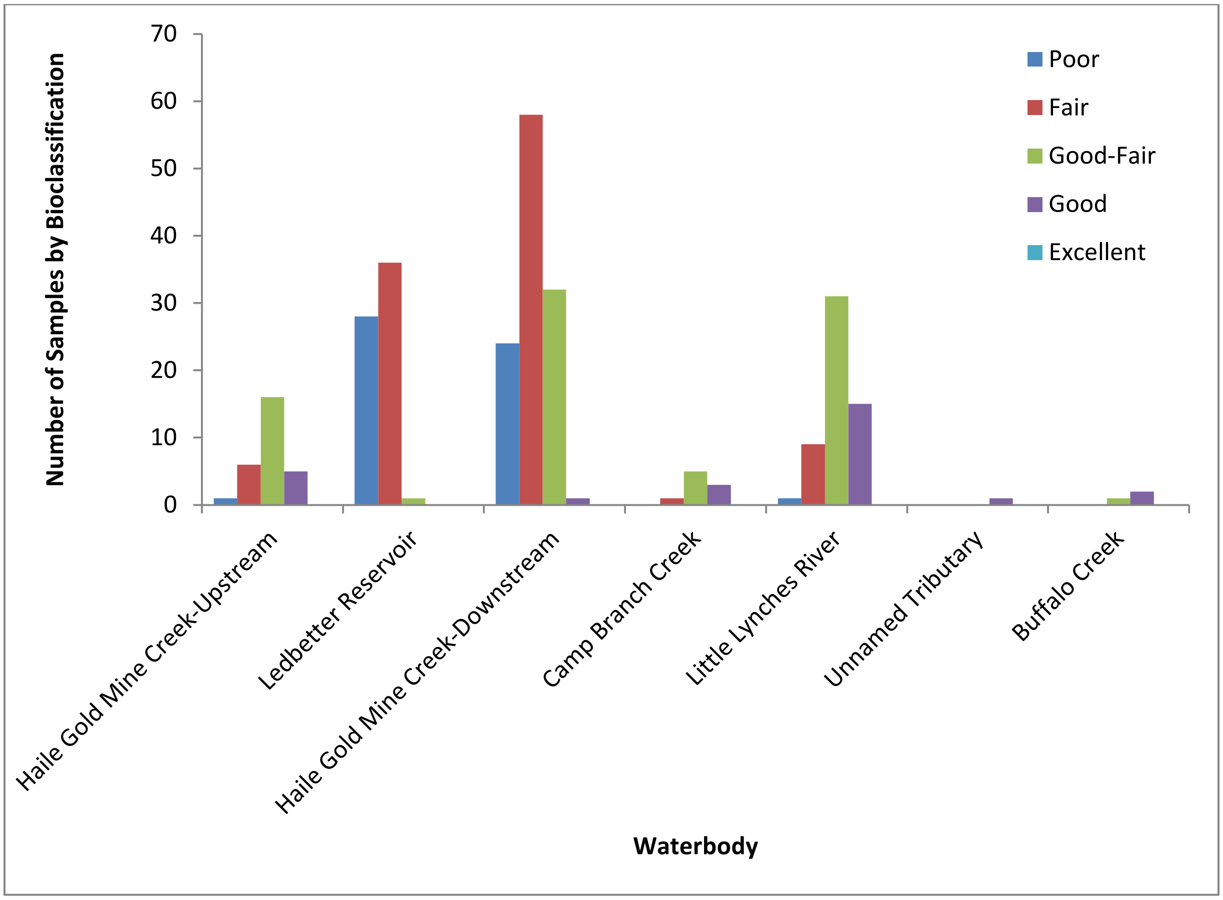


Figure 3.7-19 Bioclassification Scores by Waterbody (1990–2012)

Two sections of the Little Lynches River (stations 10 and 11) have been sampled since 1990, and a third upstream location (LL-10) was added in April 2011 (Figure 3.7-17). The EPT and BI for the more downstream sections, sampled since 1990 to determine whether Haile Gold Mine Creek had any influence on the ecological health of the Little Lynches River, were relatively high over the entire sampling period (Appendix L). With very few exceptions, stations 10 and 11 were considered able to fully support aquatic life since 2004 (ETT assessments from 2004 through 2011). Four locations were added during fall 2011, with scores ranging from "poor" to "fair." These locations were located both upstream and downstream of Haile Gold Mine Creek, with various riparian disturbances including agriculture and timber harvest

(ARCADIS 2012a). The same locations were sampled again in April 2012, except for LLR5. Improvement in bioclassification scores was seen at all locations in spring, when more flow was observed (ARCADIS 2012b). All locations in the Little Lynches River were considered to either partially or fully support aquatic life throughout the course of sampling (Table 3.7-7 and Figure 3.7-19).

The various reaches on Haile Gold Mine Creek both upstream and downstream of Ledbetter Reservoir have fluctuated between partially supporting and not supporting aquatic life since 1990 (Table 3.7-7 and Appendix L). There does not appear to be any trend of increasing or decreasing scores over time; some of the sampling events represent a time when the previous mine was operational and then went through a reclamation period (ETT assessments from 1991 through 2011). In the ARCADIS (2012a) report, the lower scores were noted and were attributed mainly to the drier conditions and the lower developmental stages of the macroinvertebrates. All locations surveyed in Haile Gold Mine Creek in 2012 were considered partially able to support aquatic life, with bioclassification scores of either “fair” or “good-fair” for all locations (ARCADIS 2012b).

### *Freshwater Mussels*

Six separate reports describe the Lynches River and Little Lynches River basins and summarize the results of surveys for freshwater mussels (see Section 3.9 for additional information on federally listed mussel species), more specifically the endangered Carolina heelsplitter (*Lasmigona decorata*) (USFWS 2006). Figure 3.7-20 illustrates the sampling locations for all freshwater mussel surveys conducted in the study area from 1986 to 2011, and Table 3.7-8 summarizes the total number of species observed and whether the Carolina heelsplitter was observed in any waterbody during the survey.

**Table 3.7-8 Summary of Mussel Species Observed by Survey (1986–2011)**

| Source of Survey Results[a] | Number of Locations | Waterbodies Surveyed | Total Number of Species Observed | Carolina Heelsplitter Observed? |
|---|---|---|---|---|
| Keferl and Shelley (1988)[b] | 6 | Lynches River | 7 | Yes |
| Keferl (1991)[c] | 2 | Lynches River and Flat Creek | 6 | Yes |
| Keferl (1992) | 11 | Haile Gold Mine Creek and Little Lynches River | 0 | No |
| Keferl (2008) | 12 | Gault Lake, Haile Gold Mine Creek, Ledbetter Reservoir, and Little Lynches River | 2 | No |
| Keferl (2010) | 5 | Camp Branch Creek | 0 | No |
| Alderman (2011) | 15 | Haile Gold Mine Creek, Little Lynches River, Camp Branch Creek, Buffalo Creek, and Unnamed Tributary | 5 | No |

a The year of the source reference represents the year in which sampling was conducted, except as noted for Keferl and Shelley (1988) and Keferl (1991).

b Sampling surveys were conducted during fall 1986 and fall 1987.

c Sampling surveys were conducted from August to October 1990.

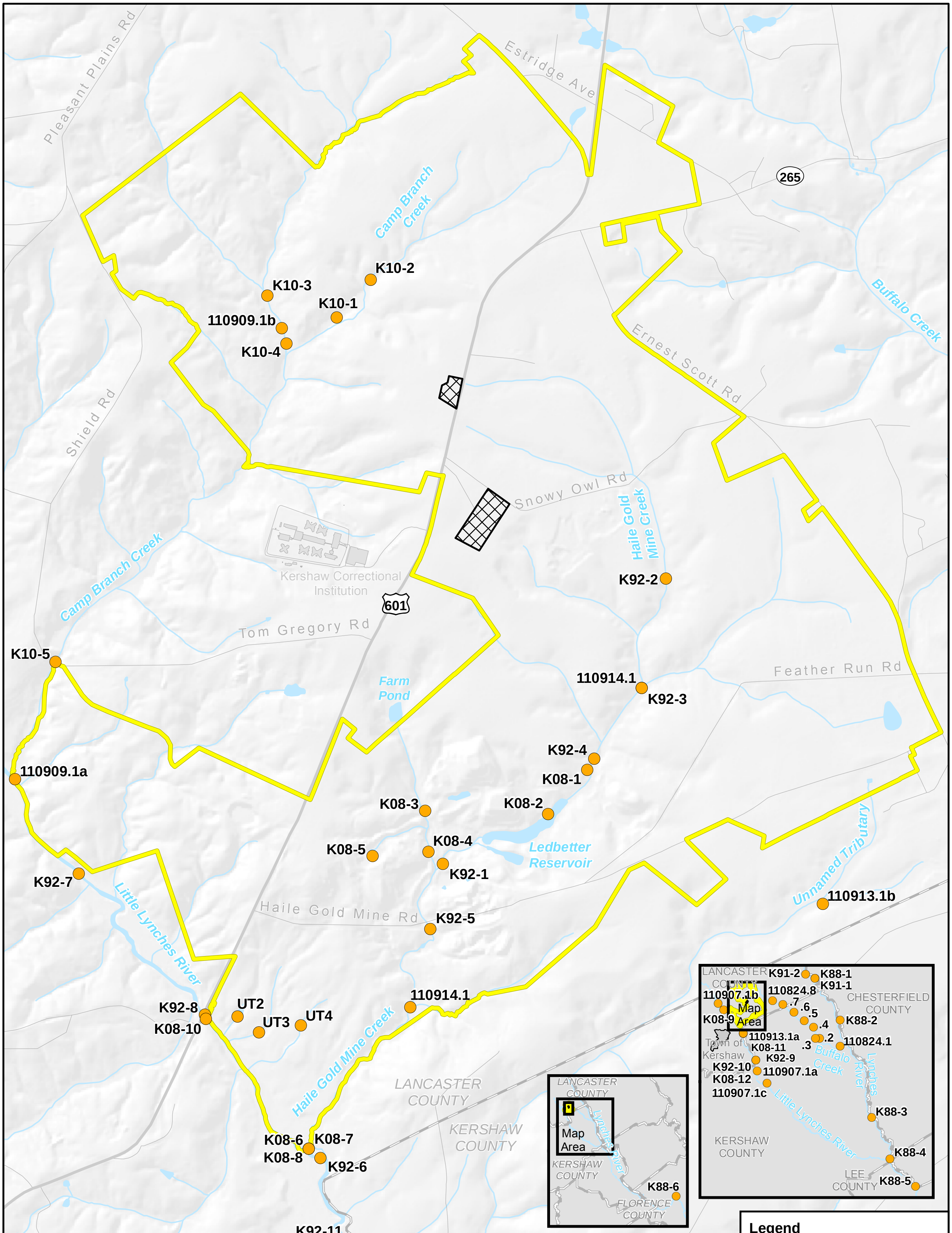


Figure 3.7-20

**Sampling Locations for Freshwater Mussel Surveys in the Study Area (1986-2011)**

0 1,000 2,000 Feet

0 300 600 Meters

Sources: AES 2011, ESRI 2008, Keferl 2011.

**Legend**

- Project Boundary
- Not Part of Project
- All Freshwater Mussel Sampling Locations
- County Boundary

The goal of the earliest surveys conducted by Dr. Keferl was to determine the presence of the Carolina heelsplitter in the Lynches River basin of South Carolina. In the first study, the Lynches River at two locations and Flat Creek (a tributary to the Lynches River) were surveyed in 1986/1987 Keferl and Shelley 1988). The Carolina heelsplitter was observed during fall 1986 in the Lynches River. Three moderate priority species were observed in the Lynches River during this survey as well (eastern elliptio [*Elliptio complanata*], Carolina slabshell [*Elliptio congaraea*], and eastern creekshell [*Villosa delumbis*]). This was one of the first documentations of the Carolina heelsplitter in South Carolina and led to additional surveys in more tributaries to the Lynches River along with the Little Lynches River. Haile Gold Mine Creek and the Little Lynches River were more thoroughly surveyed in 1992 (Keferl 1992). Six locations were surveyed in Haile Gold Mine Creek (K92-1 through K92-6), and five locations were surveyed in the Little Lynches River (K92-7 through K92-11) (Figure 3.7-20); no mussel species were observed.

In 2008, another survey for the Carolina heelsplitter was conducted in Haile Gold Mine Creek and the Little Lynches River (Keferl 2008). Four locations were surveyed in Haile Gold Mine Creek (K08-1, K08-3, K08-4, and K08-6), and six locations were surveyed in the Little Lynches River (K08-7 through K08-12) (Figure 3.7-20). No mussels were collected or observed in Haile Gold Mine Creek, but two bivalve species were noted in the Little Lynches River, the Asian clam (*Corbicula fluminea*) and the eastern pondhorn (*Uniomerus carolinianus*). The Asian clam is an introduced species and the eastern pondhorn is considered a common species. No other mussels were collected or observed during this survey. In 2010, five reaches within Camp Branch Creek were surveyed, and no mussel species were observed at any location (Keferl 2010).

The most recent survey for the Carolina heelsplitter and other freshwater mussels was completed by Alderman and Alderman (AES 2011). No mussels were collected from Haile Gold Mine Creek during this survey. The Asian clam was observed in Camp Branch Creek and the Little Lynches River. A species of pond snail (*Physa* sp.) was collected in the Little Lynches River along with the two-ridge rams-horn (*Helisoma anceps*), a common species in South Carolina. Outside of the Project area in Buffalo Creek, four eastern pondhorn shells and three eastern elliptio shells were collected.

Combining all surveys, the Carolina heelsplitter was observed only in the Lynches River (Keferl and Shelley 1988; Keferl 1991) and Flat Creek (Keferl 1991). A total of 17 different species were observed in the Lynches River watershed, with only four species observed in the Little Lynches River. Based on a review of observations within the Lynches River (Keferl 1991) and habitat requirements, two additional highest priority species (Carolina creekshell [*Villosa vaughaniana*] and creeper [*Strophitus undulates*]), one high priority species (rayed pink fatmucket/eastern lampshell [*Lampsilis splendida/radiata*]), and two moderate priority species (Atlantic spike [*Elliptio producta*] and variable spike [*Elliptio icterina*]) could be found within the study area (SCDNR 2005b) but would be limited to downstream portions of the Little Lynches River closer to the confluence with the Lynches River.

### *Amphibians/Reptiles*

Two herpetological surveys have taken place in the study area. Those surveys occurred in fall 2011 and spring 2012 as part of the comprehensive aquatic resources survey. ETT conducted the fall 2011 herpetological survey in conjunction with macroinvertebrate sampling (ARCADIS 2012a). The second event occurred concurrently with the April 2012 local fish community sampling (ARCADIS 2012b). Although a 1993 herpetological survey was planned, it did not occur because of drought conditions. However, incidental observations of herpetological species were recorded in the Project area as part of a terrestrial wildlife survey (Needham, Jernigan & Associates 1993).

Combining the results of the 2011 and 2012 herpetological surveys, incidental observations in 1993 and during the migratory fish survey, and Cardno ENTRIX staff observations during the April and October 2012 site visits, at least 27 different herpetological species were observed in the Project area (Table 3.7-9) (Appendix L). Most of the species recorded in October/November 2011 were collected with a dip net (or other equipment used during macroinvertebrate sampling) or were observed along the banks. Almost all of the species observed were considered common, except for the northern cricket frog (*Acris crepitans*) and the common snapping turtle (*Chelydra serpentina*) with SCDNR moderate priority conservation status. Both species were observed in Haile Gold Mine Creek (Figure 3.7-21).

**Table 3.7-9 Summary of Herpetological Species Observed by Survey (1993–2012)**

| Source of Survey Results[a] | Number of Locations | Waterbodies Surveyed | Total Number of Species Observed |
|---|---|---|---|
| Needham, Jernigan & Associates (1993) | 5 | Haile Gold Mine Creek, Little Lynches River, Ledbetter Reservoir, Farm Pond, and Haile Gold Mine property | 6 |
| Rohde (2008) | 10 | Haile Gold Mine Creek, Little Lynches River, and pond downstream of Snake Pit | 3 |
| Rohde (2010) | 6 | Camp Branch Creek | 1 |
| ARCADIS (2012a) | 15 | Haile Gold Mine Creek, Little Lynches River, Camp Branch Creek, Buffalo Creek, and Unnamed Tributary | 9 |
| ARCADIS (2012b)[b] | 6 | Little Lynches River, Camp Branch Creek, Haile Gold Mine Creek, and Champion Branch Creek | 5 |
| ARCADIS (2012b) | 15 | Haile Gold Mine Creek, Little Lynches River, Camp Branch Creek, Buffalo Creek, and Unnamed Tributary | 14 |

a The year of the source reference represents the year in which sampling was conducted.

b This represents the results of the migratory fish surveys that were conducted separate from the annual fish community surveys.

During the migratory fish surveys, slider turtles (*Trachemys scripta*), water moccasins (*Agkistrodon piscivorus*), and common snapping turtles were observed along the banks of the Little Lynches River or were collected with the sampling equipment. Only a green frog (*Lithobates clamitans*) was observed in Haile Gold Mine Creek. A total of five frog species, three salamander species, two turtle species, one lizard, and one snake were observed. All observed species were considered common, except for the yellowbelly slider (*Trachemys scripta scripta*), which has an SCDNR priority status of high.

Even though only two formal surveys were conducted, the number of species observed represent a moderate diversity. Based on the various habitats found in the study area and the regional ranges of the species observed during surveys, a fairly high diversity of species is expected. ARCADIS performed a desktop review of the known ranges of herpetological species, habitat suitability in the Project area, and documented occurrences in Lancaster and Kershaw Counties (Exhibit RAI 3-AR-12). They determined that, in addition to the species encountered during surveys, there was a high chance for 20 other species, a moderate chance for 31 other species, and a low chance for 25 other species to be found in the Project area (Exhibit RAI 3-AR-12). Based on range and habitat connectivity, additional SCDNR priority species could reside in the study area (Table 3.7-10).

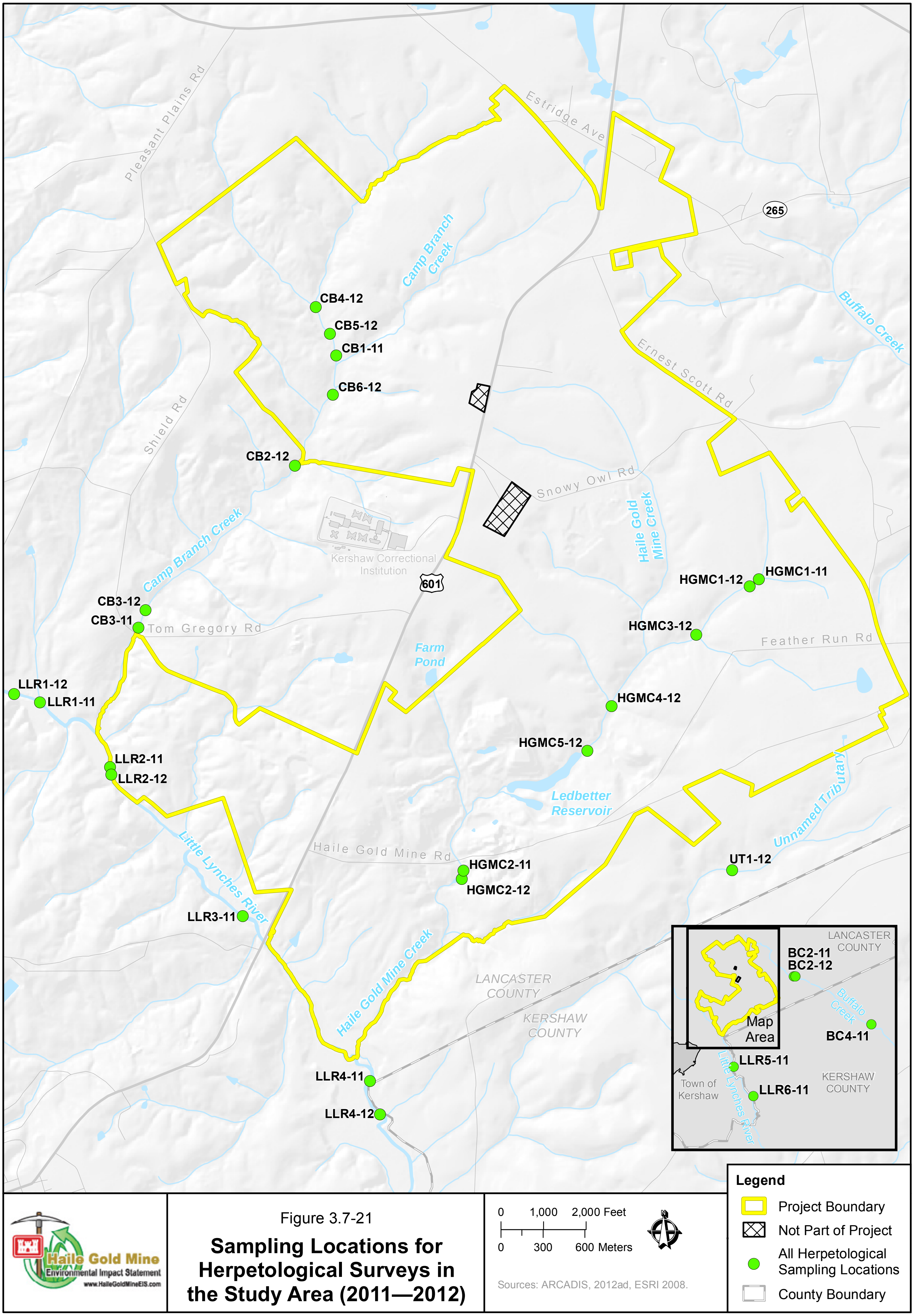


Figure 3.7-21

**Sampling Locations for Herpetological Surveys in the Study Area (2011—2012)**

**Table 3.7-10 South Carolina Priority Herpetological Species Observed or with the Potential to Occur in the Study Area**

| Common Name | Scientific Name | South Carolina Priority Species Conservation Status | Potential for Occurrence in the Study Area |
|---|---|---|---|
| Carolina gopher frog | *Lithobates capito capito* | Highest | Potential |
| Coral snake | *Micrurus fulvius* | Highest | Potential |
| Pine-barrens treefrog | *Hyla andersoni* | Highest | Potential |
| Southern hognose snake | *Heterodon simus* | Highest | Potential |
| Tiger salamander | *Ambystoma tigrinum* | Highest | Potential |
| Black swamp snake | *Seminatrix pygaea* | High | Potential |
| Florida cooter | *Pseudemys floridana* | High | Potential |
| Four-toed salamander | *Hemidactylium scutatum* | High | Potential |
| Pine snake | *Pituophis melanoleucus melanoleucus* | High | Potential |
| River cooter | *Pseudemys concinna* | High | Potential |
| Spiny softshell turtle | *Apalone spinifera* | High | Potential |
| Striped mud turtle | *Kinosternon baurii* | High | Potential |
| Upland chorus frog | *Pseudacris triseriata* | High | Potential |
| Yellowbelly slider | *Trachemys scripta scripta* | High | Observed |
| American alligator | *Alligator mississippiensis* | Moderate | Potential |
| Southern dusky salamander | *Desmognathus auriculatus* | Moderate | Potential |
| Spotted turtle | *Clemmys guttata* | Moderate | Potential |
| Northern cricket frog | *Acris crepitans* | Moderate | Observed |
| Common snapping turtle | *Chelydra serpentina* | Moderate | Observed |

Note: For herpetological species observed or with the potential to occur in the study area, 24 were classified as highest priority, 21 as high priority, and seven as moderate priority (SCDNR 2005b).

### *Aquatic Plants/Periphyton*

No formal surveys have been conducted for periphyton or aquatic plants. Any observations of either were noted during surveys conducted for other species (Appendix L). Rohde (2008) noted emergent aquatic vegetation at two locations in Haile Gold Mine Creek (R08-1 and R08-2), with burr-reed (*Sparganium* sp.) noted at R08-1 (Figure 3.7-10). During most of the benthic macroinvertebrate sampling events, algal mats were observed in Haile Gold Mine Creek immediately downstream of Ledbetter Reservoir (3A in Figure 3.7-17), and emergent aquatic vegetation in the form of cattails (*Typha* sp.) were observed (ETT annual assessments from 1990 through 2011).

No aquatic vegetation or periphyton was observed in October 2011 at the headwaters of Haile Gold Mine Creek (HGMC1-11 in Figure 3.7-4), but some filamentous algal mats were observed downstream of Ledbetter Reservoir. At the farthest upstream station for Camp Branch Creek (CB1-11 in Figure 3.7-4) green filamentous algae, knotweed (*Polygonum* sp.), burr-reed, and other emergent aquatic species were observed. A red-brown algae was noted at both CB2-11 and CB3-11 in Figure 3.7-4, which are located farther downstream and are part of the mainstem of the stream. No aquatic vegetation was observed in the Little Lynches River upstream of Camp Branch Creek (LLR1-11); however, a dark red/brown periphyton was noted at the farthest downstream Little Lynches River location (LLR6-11) (Figure 3.7-4). Sedges (*Carex* spp.) were growing on the banks of Buffalo Creek, the stream outside the Project boundary (ARCADIS 2012a).

Notes on vegetation were incorporated into the habitat assessment portion of the *Spring 2012 Aquatic Resource Surveys Report* (ARCADIS 2012b). No aquatic vegetation was observed at HGMC3-12 in Figure 3.7-4 but was noted at all other locations. A filamentous algae was present on epifaunal substrate or floating on the water's surface at all other sampling locations (HGMC4-12, HGMC5-12, CB4-12, CB5-12, and CB6-12 in Figure 3.7-4). Various emergent aquatic vegetation species also were observed at the sampling locations. They included sedges, rushes (*Juncus* spp.), American burr-reed (*Sparganium americanum*), and Asian spiderwort (*Murdannia kiesak*). All observed species were considered common or, in the case of the Asian spiderwort, an introduced species. The main reason for little periphyton cover or algae presence is the moderate to dense canopy cover encountered at most of the surveyed stream reaches, along with the tannic waters and moderate flow.

### Man-Made Lakes

#### *Fish*

Only one survey conducted in the study area had a sampling location in Ledbetter Reservoir. In 1993, two species of fish and a total of four individuals were collected there (Rohde 1993). The species collected in the reservoir were the pirate perch (*Aphredoderus sayanus*) and bluegill (*Lepomis macrochirus*). No other surveys were conducted in man-made lakes in the study area.

#### *Benthic Macroinvertebrates*

Surveys for benthic macroinvertebrates have been conducted only in Ledbetter Reservoir. Three locations (upper, middle, and lower sections) have been sampled since 1987 (Enwright Laboratories 1988a, 1988b, 1988c, 1989, 1990). During the most recent surveys (2008–2011), none of the locations were considered able to support aquatic life based on the ALUS criteria. Most locations have had EPT and BI scores of 1.0, giving the lake an overall bioclassification designation of "poor" (ETT annual assessments from 2008 through 2011). The highest bioclassification for the lake since 1990 (Table 3.7-7) (Appendix L) was "good-fair," meaning that it could partially support aquatic life (ETT annual assessments from 1990 through 2007). It should be noted that the biotic indices used to analyze results for Ledbetter Reservoir, which is a lentic (or non-flowing) system, are designed for flowing systems and may not be reliable.

#### *Freshwater Mussels*

In 2008, the upper end of Ledbetter Reservoir was surveyed for mussels (Keferl 2008). No mussels were observed at this location. No other surveys were conducted for the presence of any freshwater mussel, and more specifically no surveys for the Carolina heelsplitter.

#### *Amphibians/Reptiles*

Based on a review of the available information, no formal surveys for herpetological species were performed in Ledbetter Reservoir or Snake Pit. Some of the incidental observations from 1993 could have been around these regions, but some of the locations are listed only as "on-site" (Needham, Jernigan &

Associates, Inc. 1993). Mole salamanders (*Ambystoma* sp.) and unknown tadpoles were observed in a pool downstream of Snake Pit, but no herpetological species was directly observed in either man-made feature (Rohde 2008).

### *Aquatic Plants/Periphyton*

Aquatic plants and periphyton were observed during the various macroinvertebrate sampling events in Ledbetter Reservoir (ETT annual assessments from 1991 through 2011). The more upstream section had emergent aquatic vegetation (2B in Figure 3.7-17); the middle portion of the lake had grasses, rushes, and emergent aquatic species (2C in Figure 3.7-17); and the more downstream section had eel grass (*Vallisneria* sp.), a submergent aquatic species. No other aquatic plant species or periphyton were noted during other surveys that occurred in Ledbetter Reservoir (Rohde 1993 and Keferl 2008), and no observations were recorded at Snake Pit (Rohde 2008).

## Wetlands

Based on a review of the available information, no formal surveys have been conducted for fish or herpetological species within the wetlands in the study area. All of the surveys have taken place in streams or man-made lakes. During times of high water, it is possible for species found in the headwaters of Haile Gold Mine Creek or Camp Branch Creek to migrate to the wetlands for protection or another food source.

Surveys for freshwater mussels are generally not conducted in wetlands due to the requirements of those species (steady flows, riffles/pools, or a fish host) (Keferl 2008). Most benthic macroinvertebrates also cannot move as rapidly as fish or herpetological species; therefore, if the wetlands dry out quickly or generally do not hold water for most of the year, they would not have any colonizers.

It is possible for both amphibians and reptiles to be present in the wetlands within the Project boundary year round, but there have been no surveys to support this prediction. In 1993, some herpetological species were observed within the Project boundary, but the exact location is not known (Needham, Jernigan & Associates 1993). The desktop exercises mentioned previously (in the discussion on streams) for determining the presence of fish and herpetological species in the study area also would apply to wetlands (Tables 3.7-1 and 3.7-10).

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# 3.8 Terrestrial Resources

The section addresses vegetation and wildlife terrestrial resources, including priority conservation species. Species listed as threatened, endangered, or candidate by USFWS pursuant to the ESA are addressed in Section 3.9, "Federally Listed Species"; and aquatic resources are discussed in Section 3.7, "Aquatic Resources."

The study area for terrestrial resources encompasses the Project area and land within approximately 0.5 mile of the Project boundary.

Key issues of concern for vegetation resources include vegetation clearing and subsequent diversity of vegetation in reclaimed areas, potential impacts of groundwater drawdown on terrestrial vegetation, ongoing disturbance during mining (dust, disturbance, and invasive species), potential impacts on state-listed plant species, and re-establishment during reclamation of less diverse and productive terrestrial communities.

Key issues of concern for terrestrial wildlife (birds and mammals) include temporary habitat loss and alteration, potential impacts on special-status species, ongoing disturbance during mining (dust, noise, and human activity), wildlife injury or mortality, and the potential for animals to be exposed to contaminants, including cyanide at the TSF.

## 3.8.1 Regulatory Setting

The following regulations are applicable to terrestrial resources in the study area. See Appendix F for further details on regulations that apply to the Project.

- **Endangered Species Act –** The ESA is the primary federal law protecting threatened and endangered species. The ESA and its subsequent amendments provide for the protection and conservation of federally listed species and the habitats upon which they depend.
- **Migratory Bird Treaty Act –** Migratory birds and their nests are protected under the MBTA, which prohibits any take of migratory birds and their nests.
- **Bald and Golden Eagle Protection Act –** The Bald and Golden Eagle Protection Act protects those two species and their nests beyond the protection afforded by the MBTA.

## 3.8.2 Existing Conditions

### 3.8.2.1 Vegetation

The Project area is located in the transition between the Southeastern Plains (Level III)-Sandhills (Level IV) ecoregion and the Piedmont (Level III)-Carolina Slate Belt (Level IV) ecoregion (Griffith et. al. 2002) (Figure 3.8-1).

The Southeastern Plains-Sandhills ecoregion occurs on the higher ridges, on hilltops, and at higher elevations in the northeast part of the Project area (Figure 3.8-1). The ecoregion currently is irregular plains with broad interstream areas of cropland, pasture, woodland, and forest. The forest is predominately oak-hickory-pine interspersed with managed loblolly pine and mixed beech (*Fagus grandifolia*), sweetgum (*Liquidambar styraciflua*), southern magnolia (*Magnolia grandiflora)*, laurel (*Laurus* sp.), live oaks (*Quercus virginiana*), and various pines (*Pinus* spp.) on moist sites.

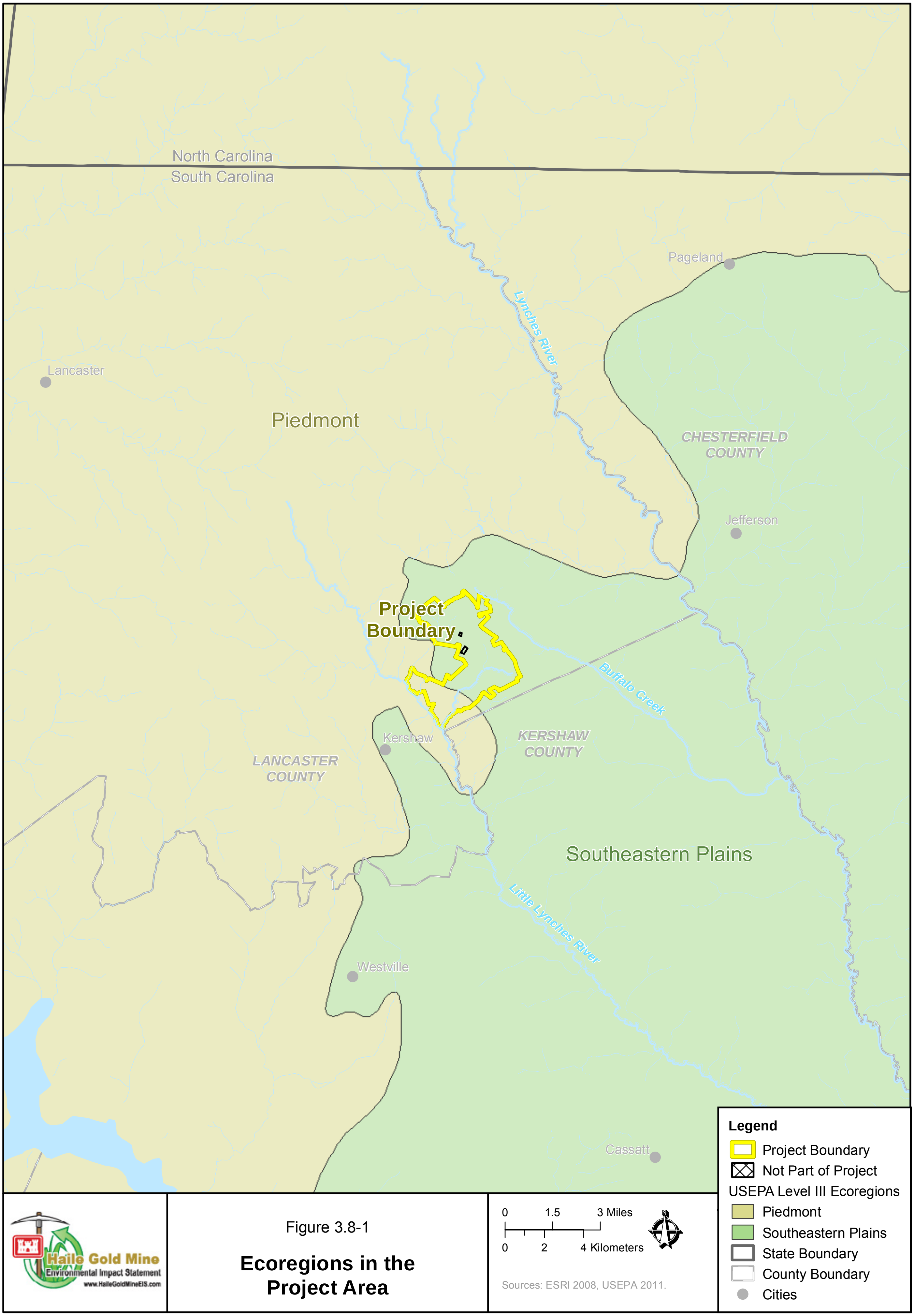


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Figure 3.8-1

**Ecoregions in the Project Area**

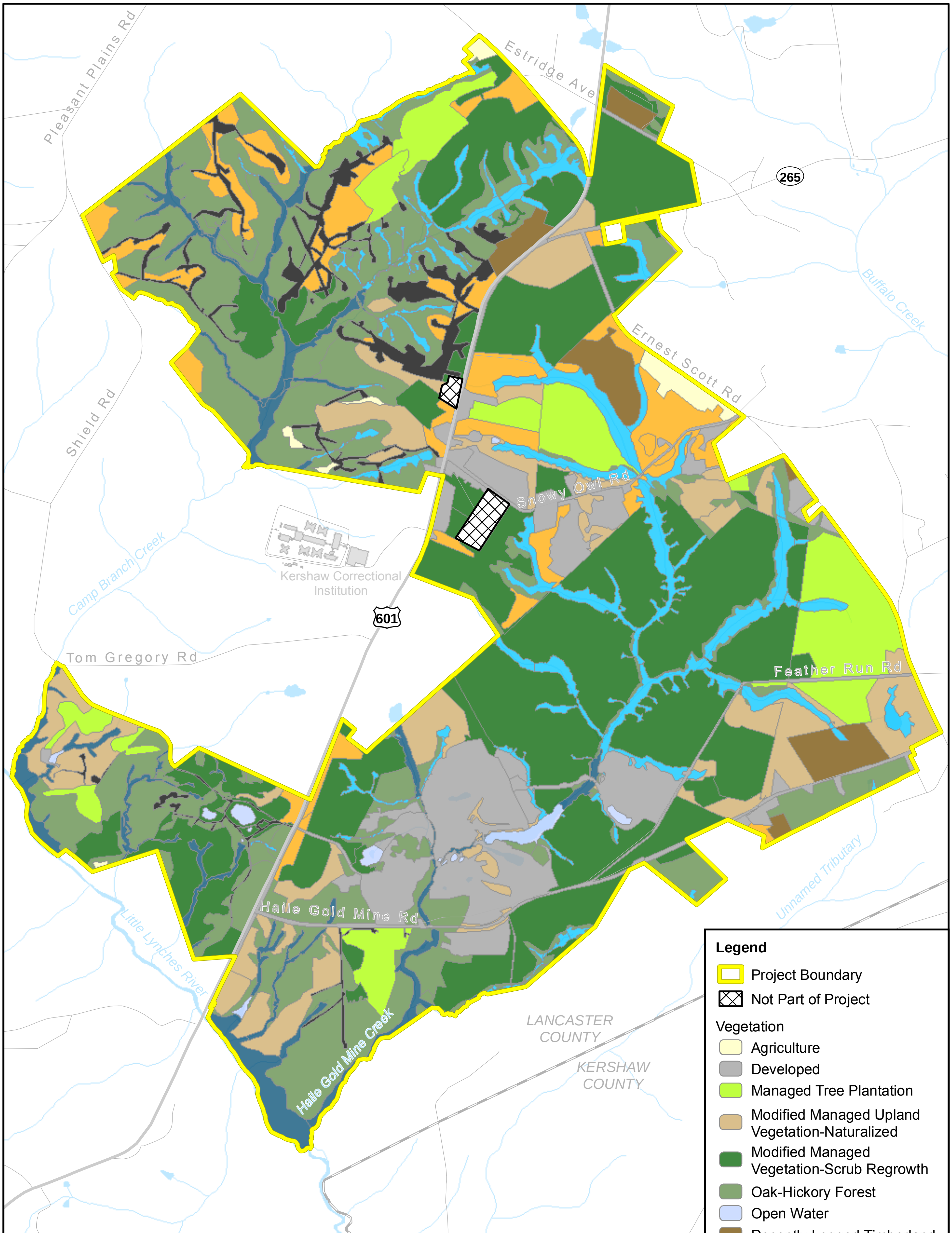
Sources: ESRI 2008, USEPA 2011.

The Piedmont-Carolina Slate Belt ecoregion occurs in the lower-lying drainages and tributaries along the Little Lynches River, in the southwest part of the Project area (Figure 3.8-1). This ecoregion is characterized by gently rolling hills, dissected irregular plains, and low rounded hills and ridges. Human activity has affected vegetation in this ecoregion to a greater degree than in other ecoregions. Hardwood and short-leaf pine (*Pinus echinata*) forests have been cleared for agriculture fields, many of which were abandoned over time and eroded. The commercial loblolly pine also was introduced and now dominates much of the ecoregion.

Twelve natural and modified vegetation types occur in the study area, based on *the Natural Communities of South Carolina* (Nelson 1986) (Figure 3.8-2). Four of these types are natural communities, and eight are land use/non-natural communities that have been modified through the actions of humans (Table 3.8-1). Each vegetation type is briefly described below.

- **Oak-Hickory Forest –** Oak-hickory forest is a natural community that occurs on upland hillslopes and ridges throughout the region and in the Project area; it transitions to more mesic or wetland forests in low topographic areas at the bottom of hillslopes. The species composition varies from site to site, with combinations of mature southern red oak (*Quercus [Q.] falcata),*northern red oak *(Q. rubra),*white oak *(Q. alba),* and mockernut hickory (*Carya alba)* typically dominating the overstory. Loblolly pine is frequently intermixed in the canopy,[1] particularly near managed tree plantations. The canopy is dense (approximately 80 percent cover), and tree height ranges from approximately 20 to 40 feet. The diameter at breast height (dbh) of hardwoods is usually less than 10 inches, while loblolly pine measure from approximately 11 to approximately 17 inches dbh. The midstory typically is from 30 to 70 percent cover of sapling canopy species, shrubs, and vines. The understory is sparse, usually less than 10 percent cover, and comprises various grass and forbs. Fire is probably only occasional to rare in this type. Oak-hickory forest occurs on approximately 1,043.4 acres (22.7 percent) within the Project boundary.
- **Xeric Sandhill Scrub –** Xeric sandhill scrub is a natural community that occurs rarely and is isolated to the higher-elevation dry hilltop terraces. The overstory trees contain naturally growing loblolly pine, from approximately 2 to 6 inches dbh and 20 feet tall, that provide approximately 65 to 70 percent cover. The midstory is dense, with approximately 60 to 80 percent cover, and is composed of various scrub oak species. Groundcover is absent in this community. Xeric sandhill scrub occurs on approximately 264.6 acres (5.7 percent) within the Project boundary.
- **Streamhead Pocosin –** Streamhead pocosin is a natural community that occurs in low-lying topographic sites in the northwest, central, and eastern portions of the Project area. This community consists of vegetated wetlands in sites saturated by seepage of shallow groundwater at the headwaters of small stream channels. The canopy is dominated by various tree species, including swamp blackgum (*Nyssa biflora),* red maple *(Acer rubrum),* sweetgum *(Liquidambar styraciflua),*sweet bay *(Magnolia virginiana),* tulip poplar *(Liriodendron tulipifera)*, and water oak (*Quercus nigra)*. Hardwoods are approximately 2 to 4 inches dbh, from 20 to 50 feet tall, and have a dense canopy (approximately 80 percent cover). The midstory is dense, with approximately 70 to 80 percent cover of sapling canopy species, shrubs, and vines; and the understory is abundant in the more saturated areas. Streamhead pocosin occurs on approximately 272.1 acres (5.9 percent) within the Project boundary.

[1] The *canopy* refers to the uppermost level or layer of a forest formed by tree crowns; the *overstory* is the uppermost layer of vegetation formed by trees; the *midstory* is the layer of vegetation between the canopy or overstory and the *understory* or grass and forb (broad-leaf, non-grass herb) layer.




**Legend**

- Project Boundary
- Not Part of Project

Vegetation

- Agriculture
- Developed
- Managed Tree Plantation
- Modified Managed Upland Vegetation-Naturalized
- Modified Managed Vegetation-Scrub Regrowth
- Oak-Hickory Forest
- Open Water
- Recently Logged Timberland
- Small Stream Forest
- Streamhead Pocosin
- Temporary Access Road
- Xeric Sandhill Scrub
- County Boundary

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Figure 3.8-2

**Vegetation Types within the Project Boundary**

Sources: ESRI 2008, Haile 2013.

### Table 3.8-1 Vegetation Types within the Project Boundary

| Vegetation Type | Acres | Percentage of Area |
|---|---|---|
| **Natural Communities** | | |
| Oak-hickory forest | 1,043.4 | 22.7 |
| Xeric sandhill scrub | 264.6 | 5.7 |
| Streamhead pocosin | 272.1 | 5.9 |
| Small stream forest | 186.5 | 4.1 |
| **Land Use/Non-Natural Communities** | | |
| Managed tree plantation | 318.2 | 6.9 |
| Recently logged timberland | 100.7 | 2.2 |
| Modified managed upland vegetation–naturalized | 401.4 | 8.7 |
| Modified managed upland vegetation–scrub regrowth | 1,377.4 | 30.0 |
| Developed | 438.5 | 9.5 |
| Agriculture | 39.8 | 0.9 |
| Open water | 23.1 | 0.5 |
| Temporary access roads | 131.4 | 2.9 |
| **Total** | **4,597.1** | **100.0** |

- **Small Stream Forest –** Small stream forest is a natural community that occurs in low-lying topographic sites in the southern portions of the Project area. It consists of vegetated wetlands and non-wetland mesic (moderately moist) forest immediately adjacent to the Little Lynches River and lower portions of tributaries. The canopy is dense (approximately 80 percent cover), dominated by hardwood species with 2 to 4 inches dbh, and ranging in height from 20 to 50 feet. The midstory comprises sapling canopy species, shrubs and vines and ranges from 0 to 80 percent. The understory is abundant in wetter areas. (See Section 3.6 for additional discussion of wetlands.) Small stream forest occurs on approximately 186.5 acres (4.1 percent) within the Project boundary.

- **Managed Tree Plantations –** Managed tree plantations are non-natural communities that occur as evenly spaced planted rows of loblolly pine in plots ranging from 1 to more than 50 acres. Trees range from 20 to 50 feet in height and are spaced at approximately 6-foot intervals. Understory vegetation is regularly cleared during maintenance. Managed tree plantations occur on approximately 318.2 acres (6.9 percent) within the Project boundary.
- **Recently Logged Timberland –** Recently logged timberland is a non-natural community that occurs as a result of commercial logging within managed tree plantations and hardwood tree communities. Stumps are typically cleared in preparation for replanting, and slash may be scattered throughout the area. There is usually minimal vegetation regrowth at this stage, but these areas eventually develop into scrub-regrowth. Recently logged timberland occurs on approximately 100.7 acres (2.2 percent) within the Project boundary.
- **Modified Managed Upland Vegetation-Naturalized –** Modified managed upland vegetation-naturalized is a non-natural vegetation type that occurs in formerly managed tree plantations that are no longer maintained and have re-established natural vegetation. The vegetation is a mixture of herbaceous, shrub, and tree species—with the evenly spaced rows of loblolly pine interspersed with various oak species, shrubs, and vines. This type occurs on relatively large tracts throughout the

Project area. Modified managed upland vegetation-naturalized occurs on approximately 401.4 acres (8.7percent) within the Project boundary.

- **Modified Managed Upland Vegetation-Scrub Regrowth –** Modified managed upland vegetation-scrub regrowth is a non-natural vegetation type that occurs on previously cleared land where natural vegetation is re-establishing. It exhibits early successional stages with a mixture of herbaceous, shrub, and sapling trees—primarily scrub oak species. Much of the previously mined land that is revegetating exhibits this vegetative type. Modified managed upland vegetation-scrub regrowth occurs on approximately 1,377.4 acres (30.0 percent) within the Project boundary.
- **Developed –** Developed areas are a land use type that lacks natural vegetation communities; these areas are barren or planted and maintained grass in lawns, golf courses, or industrial sites. Developed lands also include areas of low-intensity residential units, such as single-family house lots, paved roadways, and mined lands. Mined lands include both historical and current operations, including roads, pits, overburden stockpiles, and other mine facilities. Developed areas occur on approximately 438.5 acres (9.5 percent) within the Project boundary.
- **Agriculture –** Agricultural land is a land use type that includes areas that have been cleared and are used to produce crops or to graze livestock. This classification includes pasture/hay land, cultivated land tilled annually for crops, and old field areas that were formerly tilled that are now reverting to a vegetation mixture of introduced and native species, which often includes weed species. Farm houses and facilities are included in this classification. Agriculture occurs on approximately 39.8 acres (0.9 percent) within the Project boundary.
- **Open Water –** Open water includes shallow ponds, deep reservoir impoundments, and pit lakes associated with artificially impounded water near agriculture or mine lands. Open water areas lack natural vegetation. Open water occurs on approximately 23.1 acres (0.5 percent) within the Project boundary.
- **Temporary Access Roads –** Temporary access roads are associated with mine exploration and timber harvesting activities. These roads are generally within natural vegetation communities, where the vegetation has been cleared with minor grading of soil to facilitate temporary access. Temporary access roads occur on approximately 131.4 acres (2.9 percent) within the Project boundary.

### State-Listed Plant Species

Surveys for state-listed and rare plant species were conducted multiple times over multiple seasons during 2008 through 2010, over habitats types that might support the species (Dumond 2010, 2012). These surveys searched for the 42 plant species that are listed on the South Carolina Rare, Threatened & Endangered Species Inventory as reported to the South Carolina Heritage Trust Program (SCDNR 2011). Six of the 42 species searched for also are federally listed and are addressed in Section 3.9.

Two state-listed plant species were found during the surveys:

- Heart-leaved foam flower (*Tierella cordifolia*) – ranked as G5 (Secure—Common, widespread and abundant, although it may be rare in parts of its range) and its state listing is SNR (Unknown Not Ranked – rank in South Carolina not yet assessed).
- Nestronia (*Nestronia umbellula*) – ranked as G4 (Apparently Secure—Uncommon but not rare, although it may be rare in parts of its range, particularly on the periphery, and usually widespread) and its state listing is S3 (Vulnerable—vulnerable to extinction either because of rare or uncommon, or found only in a restricted range [even if abundant at some locations], or due to other factors making it vulnerable to extirpation).

Heart-leaved foam flower was found in one habitat of small stream forest, of limited occurrence along Camp Branch Creek. Nestronia is a relatively common shrub found at 16 locations in recently logged timberland and modified managed upland vegetation-scrub regrowth types; it is found along upper to middle slope habitats in dry woods dominated by several species of scrub oaks and pine (Figure 3.8-3).

### Noxious Weeds

No noxious weeds have been observed in the study area. Dumond (2010) identified 614 vascular plant species, subspecies, and varieties identified growing within the Project boundary during surveys carried out from 2008 to 2010 (Appendix A in Dumond 2010), but none of these plant species are listed on the South Carolina State-Listed Noxious Weeds List (NRCS 2013).

## 3.8.2.2 Wildlife

Many wildlife species occupy the habitats in the study area. Field studies have documented the presence of wildlife typical of the region; these are described in the following sections for each of the major wildlife groups.

### Birds

Bird surveys were conducted by ARCADIS (2010) to determine the bird species using the study area. The number of birds, number of different species, and dominant species by habitat type observed are presented in Table 3.8-2. A complete list of species observed in each of the habitat types is provided in the *Comprehensive Baseline Wildlife and Aquatic Resources Report for the Haile Gold Mine Site in Lancaster County, South Carolina* (ARCADIS 2012; available at HaileGoldMineEIS.com). The Shannon Diversity Index was used to provide an estimate of species diversity for the Project area, as presented in Table 3.8-2. The Shannon Diversity Index for the Project area was 1.50, indicating low species (community) diversity, with the xeric sandhill scrub habitat showing a particularly low species diversity.

Carolina wren (*Thryothorus ludovicianus)*, American crow (*Corvus brachyrhynchos*), and northern cardinal (*Cardinalis cardinalis*) were the dominant species in the Project area, and were generally the dominant species in the natural communities and in most of the land use/non-natural communities. Those three species accounted for more than 50 percent of the top 10 species observed and accounted for 37 percent of the total birds observed during the surveys. There were no significant differences in relative abundance of the dominant species between habitat types (ARCADIS 2012).

Raptors and other large birds observed on the site include American crow (*Corvus brachyrhynchos*), black vulture (*Coragyps atratus*), great blue heron (*Ardea herodias*), red-shouldered hawk (*Buteo lineatus*), turkey vulture (*Cathartes aura*), and wild turkey (*Meleagris gallopavo).* Four potential raptor/large bird nests were observed along the Little Lynches River, Haile Gold Mine Creek, and an unnamed tributary (Figure 3.8-4). A red-shouldered hawk was observed calling approximately 50 feet from one of the nests, and its behavior indicated that the nest was likely a red-shouldered hawk nest. No bird was observed near any of the three other nests; however, the survey was conducted after the raptor nesting season and whether the nest had been active the previous nesting season could not be determined.

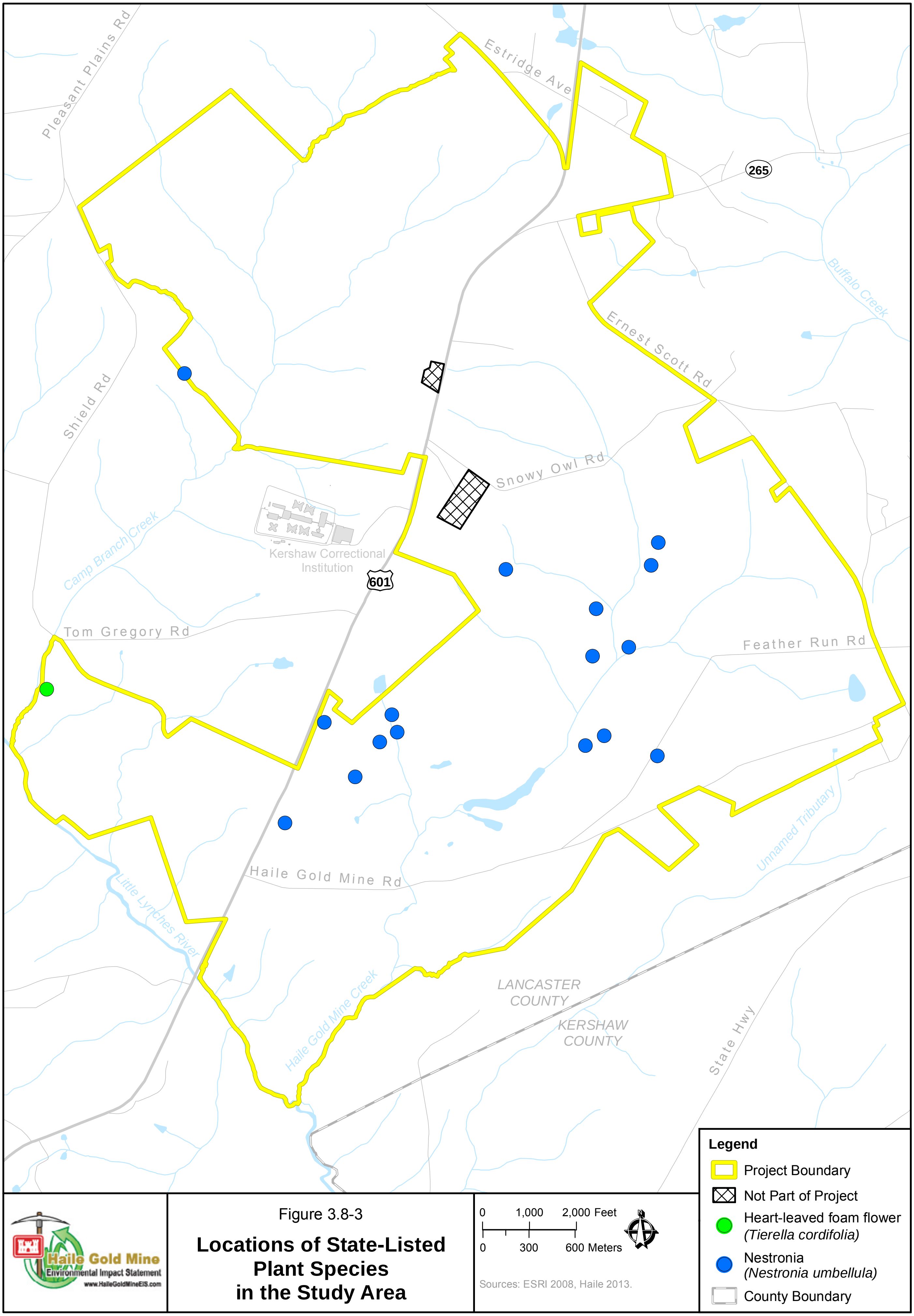


Figure 3.8-3

**Locations of State-Listed Plant Species in the Study Area**

Sources: ESRI 2008, Haile 2013.

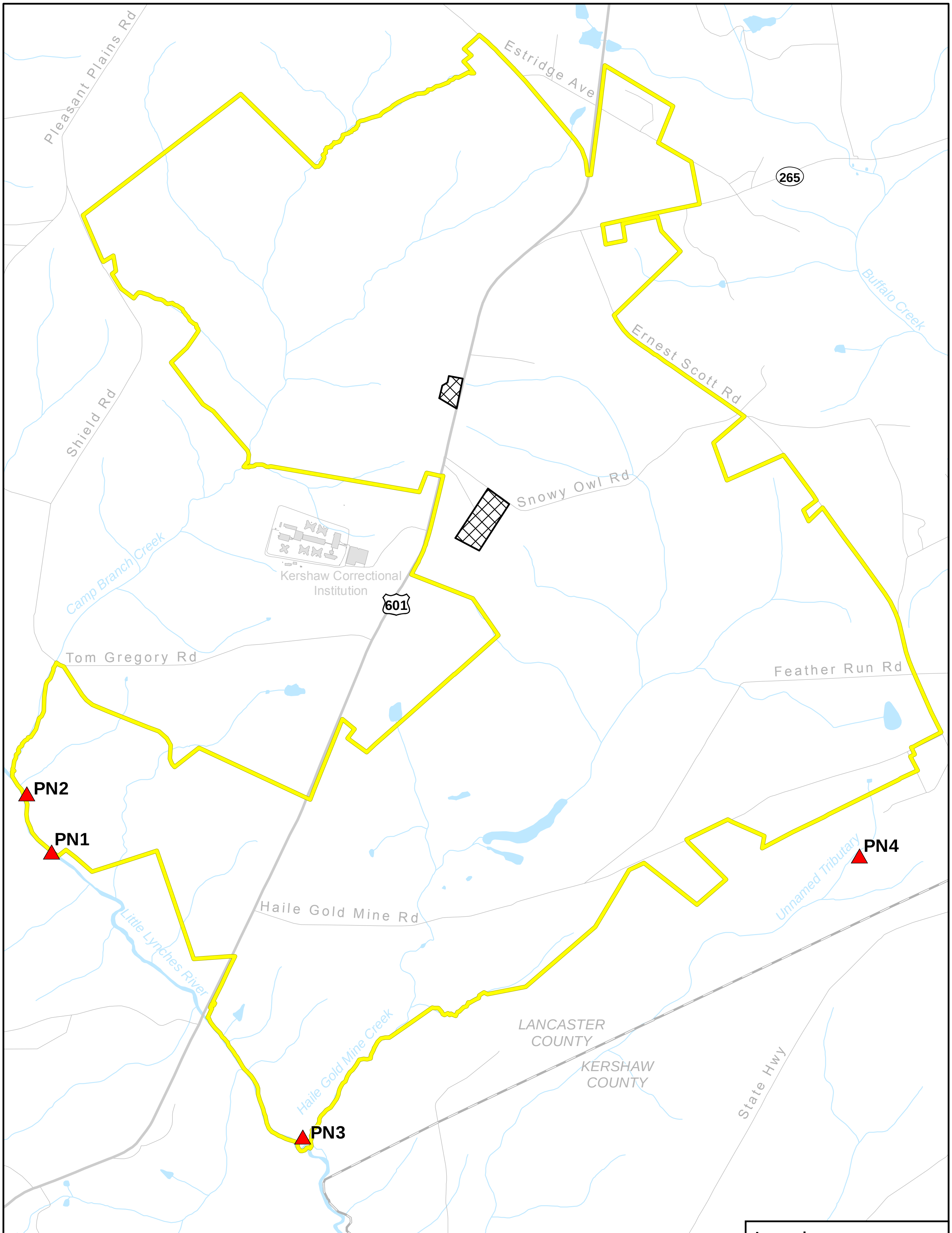


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Figure 3.8-4

**Locations of Raptor Nests in the Study Area**

Sources: ESRI 2008, Haile 2013.

### Table 3.8-2. Results of Birds Surveys in the Study Area

| Habitat Type | Number of Birds Detected | Number of Species Detected | Dominant Species | Shannon Diversity Index |
|---|---|---|---|---|
| **Natural Communities** | | | | |
| Oak-hickory forest | 221 | 27 | Carolina wren, American crow, northern cardinal | 1.448 |
| Xeric sandhill scrub | 49 | 15 | American crow, Carolina chickadee, northern cardinal | 0.885 |
| Streamhead pocosin | 162 | 15 | American crow, Carolina wren, eastern towhee | 1.638 |
| Small stream forest | 34 | 24 | Carolina wren, yellow-billed cuckoo, northern cardinal | 1.020 |
| **Land Use/Non-Natural Communities** | | | | |
| Managed tree plantation | 167 | 28 | Pine warbler, Carolina wren, Carolina chickadee | 1.827 |
| Recently logged timberland | 24 | 9 | Carolina wren, American crow | 1.402 |
| Modified managed upland vegetation-naturalized | 121 | 25 | Carolina wren, American crow, northern cardinal | 1.519 |
| Modified managed upland vegetation-scrub regrowth | 448 | 41 | American crow, Carolina wren, eastern towhee | 1.591 |
| Developed | 76 | 17 | Mourning dove, tufted titmouse, barn swallow, Carolina wren | 1.595 |
| Agriculture | 5 | 4 | Mourning dove | 1.561 |
| Open water | 11 | 9 | Carolina chickadee, Carolina wren | [a] |
| Temporary access roads | 37 | 11 | Tufted titmouse, Carolina chickadee, northern cardinal | 1.357 |
| **Project area total** | **1,355** | **49** | **Carolina wren, American crow, northern cardinal** | **1.490** |

[a] No point count location was used in the open water habitat, so the Shannon Diversity Index could not be calculated.

Source: ARCADIS 2012.

#### *Mammals*

Bat surveys were conducted at four sample points in natural vegetation community types during August through October 2012, using acoustic sampling methods. Nightly bat activity was high during the monitoring period, with approximately 61 percent of the bat activity recorded at the station near Ledbetter Reservoir. Bats identified included (1) non-Myotis species with calls are over 35 kHz, such as eastern red bat (*Lasiurus borealis*), seminole bat (*L. sminolus*), eastern pipistrelle (*Pipistrellus subflavis*), and evening bat (*Nycticeius humeralis*); and (2) species with calls over 25 kHz, which includes big brown bat (*Eptesicus fuscus*), Brazilian free-tailed (*Tadarida brasiliensis*), and silver-haired bat (*L. noctivagans*). Approximately 17 percent of the bat calls recorded during the monitoring period could not be identified to a species group.

No special-status species of bat was identified in the survey calls. Some recordings that could not be identified to species level could have included Southeastern myotis (*M. austroriparius*) and Rafinesque's big-eared bat (*Plecotus rafinesquii*). Both of these are South Carolina priority conservation species.

However, the habitat within the Project area is not suitable for those species, and neither species is known to occur in Lancaster County (SCNDR 2010). No old shaft or adit (entrance to an underground mine) for potential hibernacula (locations chosen for hibernation) is present in the Project area.

Transects to survey other mammal species in the area were conducted during October 28–30, 2011. Evidence of the following species was observed along the transects or opportunistically during other field work: feral hog (*Sus scrofa*); white-tailed deer (*Odocoileus virginianus*); coyote (*Canis latrans*); bobcat (*Lynx rufus*); beaver (*Castor canadensis*); raccoon (*Proycon lotor*); muskrat (*Ondatra zibethicus*); possum (*Didelphis marsupialis*); unidentified squirrel (family Sciuridae); unidentified rodent, mole, or vole; and Eastern cottontail rabbit (*Sylvilagus floridanus*). Evidence of feral hog was the most common sign and was present throughout natural and non-natural communities. In addition, hispid cotton rat (*Sigmodon hispidus*) and river otter (*Lutra canadensis*) were observed during 1993 field work in the area (Needham, Jernigan, & Associates 1993). The mammals observed during surveys in the Project area were found to be present mostly in the non-natural communities habitat. No special-status wildlife species was observed in the area during those surveys or during the other biological field surveys conducted for the various studies in 1993 and 2012 (Needham, Jernigan, & Associates 1993; NEI 2010; ARCADIS 2012).

### Priority Conservation Wildlife Species

Six species identified during the 2011 bird survey are SCDNR Priority Conservation Species (SCDNR 2005). These species, their priority ranking, and the habitats where the species were observed are as follows:

- **Acadian Flycatcher (*Empidonax virescens*) (High, the priority ranking just below Highest) –** One Acadian flycatcher was observed at a point count station within the modified managed upland vegetation-naturalized habitat type.
- **Brown-Headed Nuthatch (*Sitta pusilla*) (Highest, the number one priority ranking) –** Ten brown-headed nuthatches were observed in three habitat types during the survey, including managed tree plantation, modified managed vegetation-scrub regrowth, and xeric sandhill scrub.
- **Eastern Wood-Pewee (*Contopus virens*) (Highest) –** Five Eastern wood-pewees were observed in four different habitat types: managed tree plantation, modified managed vegetation-scrub regrowth, oak-hickory forest, and streamhead pocosin.
- **Field Sparrow (*Spizella pusilla*) (Highest) –** Four field sparrows were observed during the survey, all within the modified managed vegetation-scrub regrowth habitat.
- **Prairie Warbler (*Setophaga discolor*) (Highest) –** Twenty-one prairie warblers were observed during the survey, primarily in the modified managed vegetation-scrub regrowth. Other habitats in which the prairie warbler was observed include developed, managed tree plantation, recently logged timberland, and streamhead pocosin.
- **Northern Bobwhite (*Colinus virginianus*) (Highest) –**Three northern bobwhites were observed in three habitat types during the survey: streamhead pocosin, developed, and modified managed vegetation-scrub regrowth.

In addition, during field investigations carried out in 1993 (NEI 2010) American kestrel *(Falco sparverius*) (Highest) was observed in oak-hickory forest, and little blue heron (*Egretta caerulea*) (Highest) was observed in streamhead pocosin and small stream forest.

Specific surveys were conducted for bald eagle (*Haliaeelus leucocephalus*) and red-cockaded woodpecker (*Picoides borealis*). No bald eagle nest was found in the study area (ARCADIS 2012). Parnell (2008) concluded that the habitats present were not suitable for bald eagle, and the area appeared unlikely to support regular use by bald eagle. No red-cockaded woodpecker was found during the surveys. Further information on this species can be found in Section 3.9.

No mammal species ranked High or Highest on the SCDNR Priority Conservation Species (SCDNR 2005) was detected in the Project area. Species listed as threatened, endangered, or candidate under the ESA are addressed in Section 3.9.

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# 3.9 Federally Listed Species

This section describes the species listed as Threatened, Endangered, or Candidate (TEC) by the USFWS under the ESA. *Endangered species* includes any species that is in danger of extinction throughout all or a significant portion of its range. *Threatened species* indicates any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. *Candidate species* are species considered for possible addition to the List of Endangered and Threatened Species. For these species, the USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions.

Descriptions of other sensitive and special-status species (e.g., those designated as High and Highest Priority by the SCDNR [SCDNR 2005]) that have the potential to be affected by the proposed Project are presented in Sections 3.7, "Aquatic Resources" and 3.8, "Terrestrial Resources."

The study area for terrestrial resources encompasses the Project area and land within approximately 0.5 mile of the Project boundary.

As discussed below, no TEC species have been found in the study area.

## 3.9.1 Regulatory Setting

The following regulations are applicable to TEC species in the study area. See Appendix F for further details on regulations that apply to the Project.

- **Endangered Species Act –** Under Section 7 of the ESA, federal agencies (such as the USACE) are required to ensure, in consultation with the USFWS, that any federal undertaking, funding, permitting, or authorizing actions would not likely jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat.[1]
- **Migratory Bird Treaty Act –** Migratory birds and their nests are protected under the MBTA, which prohibits any take of migratory birds and their nests.
- **Bald and Golden Eagle Protection Act –** The Bald and Golden Eagle Protection Act protects those two species and their nests beyond the protection afforded by the MBTA.
- **Fish and Wildlife Coordination Act –** This act requires consultation with the USFWS and the fish and wildlife agencies of states where the "waters of any stream or other body of water are proposed or authorized, … projected or licensed to be impounded, diverted … or otherwise controlled or modified" by any agency under a federal project or license.

[1] *Critical habitat* refers to a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species, and that may require special management and protection (a more complete definition can be found in the ESA).

### 3.9.2 Existing Conditions

Threatened and endangered species known to occur in Lancaster County, South Carolina as of March 13, 2012 (USFWS 2012) include the following:

- Carolina heelsplitter (*Lasmigona decorata*) – federally listed as endangered
- Pool sprite (*Amphianthus pusillus*) – federally listed as threatened
- Smooth coneflower (*Echinacea laevigata*) – federally listed as endangered
- Schweinitz's sunflower (*Helianthus schweinitzii*) – federally listed as endangered
- Black-spored quillwort (*Isoetes melanospora*) – federally listed as endangered

The Carolina heelsplitter, a freshwater mussel, was found at two locations in the Lynches River along Flat Creek (a tributary to the Lynches River) in 1986/1987 (Keferl and Shelly 1988). Surveys of the Project area were conducted by Keferl in 1992, 2008, and 2010 to determine whether the mussel was present in the Little Lynches River basin. The 1992 surveys focused on Haile Gold Mine Creek and the Little Lynches River, where no specimens were observed (Keferl 1992). Similar areas were surveyed again in 2008 (Keferl 2008) without locating any Carolina heelsplitter. Camp Branch was surveyed in 2010; Carolina heelsplitter was not observed during this survey (Keferl 2010). Most recently, Buffalo Creek, Camp Branch Creek, Haile Gold Mine Creek, and the Little Lynches River were surveyed for the Carolina heelsplitter along with freshwater mussel species in general (AES 2011). During the 2011 survey, the Carolina heelsplitter was not observed in the Project area nor within the Little Lynches River basin. Carolina heelsplitter therefore are not expected to occur in the study area.

Surveys for pool sprite, smooth coneflower, Schweinitz's sunflower, and black-spored quillwort were conducted from 2008 through 2010 (DuMond 2010, 2012). None of these TEC plant species was found in the Project area. Many of the preferred habitats containing, or that could potentially support, the listed plant species in South Carolina are not found or do not reach full potential within the Project area. Pool sprite, smooth coneflower, Schweinitz's sunflower, and black-spored quillwort therefore are not expected to occur in the study area.

Red-cockaded woodpecker (*Picoides borealis*), a species federally and state listed as endangered, has been reported in adjacent counties but is not on the Lancaster County list of threatened and endangered species. Because the species occurs in adjacent counties and could move into Lancaster County, surveys were conducted in the Project area to document red-cockaded woodpecker habitat (ARCADIS 2012). The potential for red-cockaded woodpecker is relatively low, with only a small amount of foraging habitat present; the remainder of the Project area does not provide suitable nesting or foraging habitat. Red-cockaded woodpecker therefore is not expected to occur in the study area.

Bald eagle was removed from the federal TEC list on August 9, 2007. However, bald eagles are protected by the MBTA and the Bald and Golden Eagle Protection Act, and the USFWS has a Post-Delisting Monitoring Plan to track the status of the species (USFWS 2010). Bald eagles nest, winter roost, and forage in South Carolina; they prefer to nest in large trees with an open limb structure that are situated within 0.62 mile of open water (SCDNR 2005). Bald eagle nests have been found along the major river drainages of South Carolina's Lower Coastal Plain, in tall, live pine trees with a higher canopy than surrounding trees (SCDNR 2011). Suitable foraging sites consist of fresh, brackish, and marine open waters; marshes; and riverine habitats with abundant fish and bird prey. There are no historical reports of bald eagle nests in the study area.

To verify the status of bald eagle in the study area, surveys were conducted over the Project area and adjacent habitat during 2008 (Parnell 2008) and 2011 (ARCADIS 2012). No bald eagle was observed, and the potential for bald eagles to nest in the study area is low due to the lack of suitable nesting habitat adjacent to foraging habitat. Bald eagles therefore are not expected to occur in the study area.

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# 3.10 Socioeconomics and Environmental Justice

In addition to potential effects on environmental resources, mining activity at the Haile Gold Mine could generate a range of socioeconomic impacts and benefits within the local area, region, and state. Potential socioeconomic effects associated with gold mining are attributed primarily to the quantity and value of mineral production and associated labor requirements and spending during mine and facility development, operations, and reclamation. These activities would cause not only direct economic effects at the Haile Gold Mine but also would extend throughout the local and regional economies, particularly affecting businesses that support the mining industry and its employees. In addition, local municipalities would experience changes in tax revenues with new mining activity, along with the resultant demands for public services and local infrastructure.

Collectively, these socioeconomic and other environmental effects of the Project may have implications for environmental justice. USEPA defines *environmental justice* as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA 2012).

The study area for socioeconomics includes Lancaster, Kershaw, Richland, and York Counties (see Figure 3.10-1). This four-county region was selected based on its relative proximity to the Project area and its role in providing goods and services, as well as labor, to the Project. Specifically, these four counties represent the core areas of Project-related spending within South Carolina, capturing an estimated 68 percent of capital and operating expenditures associated with the Project; the other 32 percent of Project spending is expected to occur in other areas of the state (8 percent) and outside the state (24 percent) (Haile 2012a). Accordingly, information on existing socioeconomic conditions covers the four-county region, including the nearby Town of Kershaw and other incorporated areas where data are available. In some cases, information also is presented at the census-tract level within Lancaster County, particularly where geographic refinement is necessary to evaluate potential impacts—as is the case for the environmental justice analysis (see Figure 3.10-2). In addition, state-level information is presented to provide a context for local economic conditions. Because the Project is located within Lancaster County and most of the economic benefits would be concentrated near the Project, it is the geographic focus of the socioeconomic analysis.

The regional economic modeling, which measures the secondary economic effects associated with mine development and operations, uses the four-county region (Lancaster, Kershaw, Richland, and York Counties) as the primary modeling region, as the region captures most of the Project spending and economic linkages associated with the Project. Economic modeling also was conducted at the state level to allow decision makers to consider the statewide economic effects associated with gold mining at the Project.

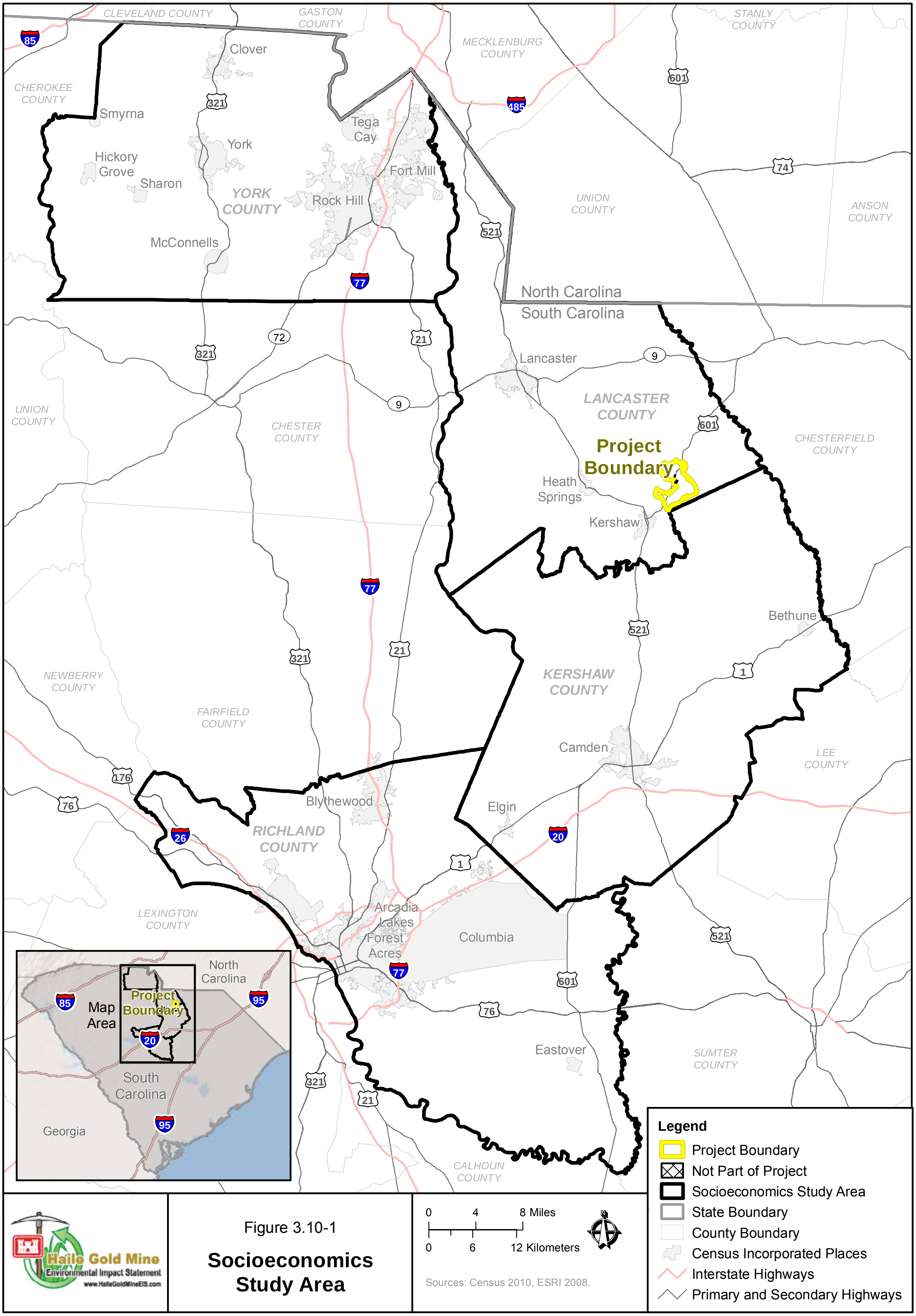
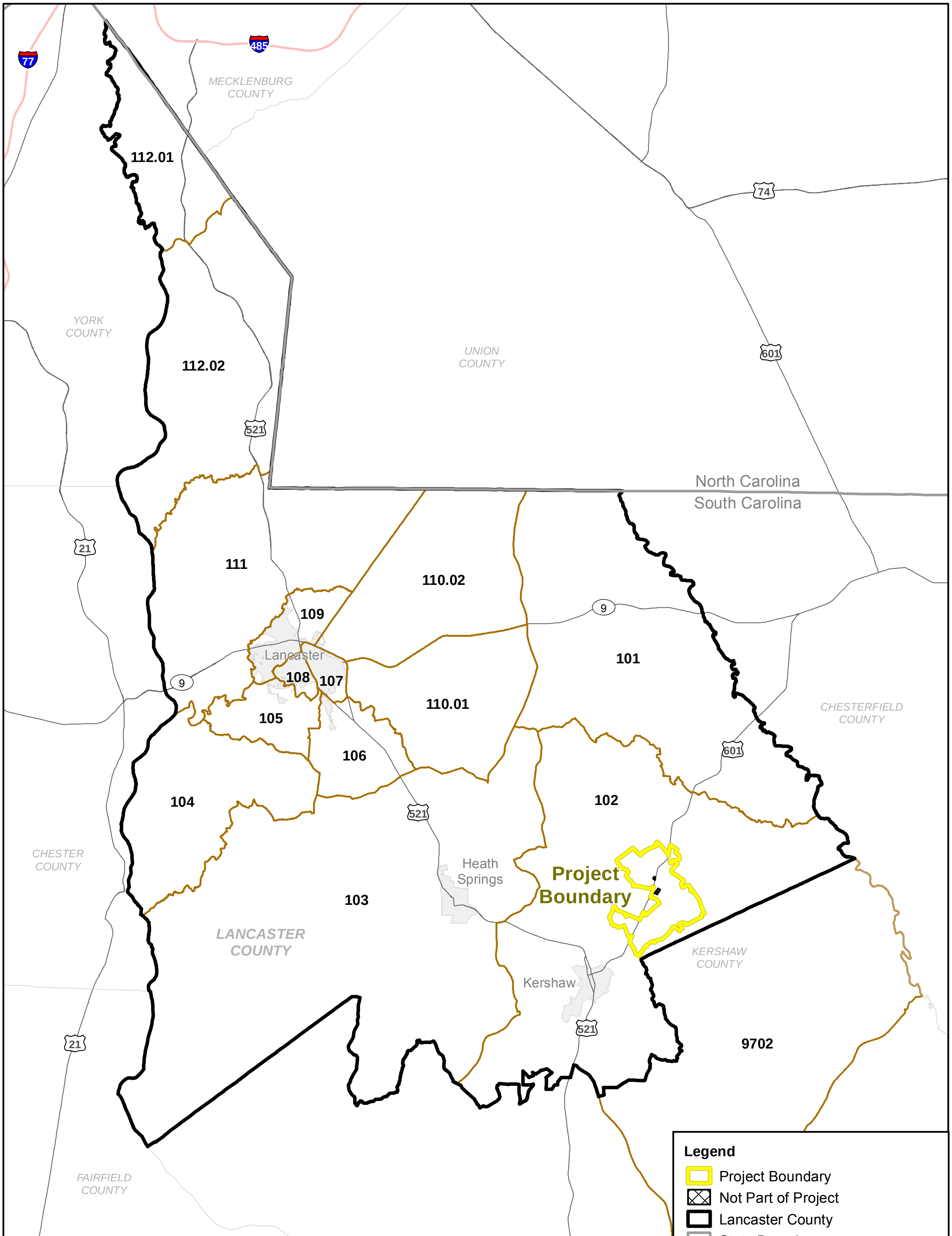



Figure 3.10-1

**Socioeconomics Study Area**




Haile Gold Mine Environmental Impact Statement
www.HaileGoldMineEIS.com

Figure 3.10-2

**Census Tracts**

0 2 4 Miles
0 3 6 Kilometers

Sources: Census 2010, ESRI 2008.

### 3.10.1 Regulatory Setting

The regulatory setting for socioeconomic resources is limited to NEPA requirements for economic analyses and policies, and regulations related to environmental justice. The CEQ *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (CEQ Regulations) describe as one of the purposes of NEPA "to inform decision-makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment," where the human environment "shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment" (40 CFR 1502.1) Further, the CEQ Regulations state that "when an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment" (40 CFR 1508.14).

The regulatory setting related to environmental justice is tied primarily to EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, dated February 11, 1994. EO 12898 requires that each federal agency

> *... Make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.*

The CEQ has oversight responsibility for the federal government's compliance with EO 12898 and NEPA. The CEQ, in consultation with the USEPA and other agencies, has developed guidance to assist federal agencies with their NEPA procedures so that environmental justice concerns are effectively identified and addressed; this guidance is presented in *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ 1997). In addition, the USEPA has prepared guidance to address environmental justice issues, including *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses* (USEPA 1998), *Final Guidance for Consideration of Environmental Justice in Clean Air Act 309 Reviews* (USEPA 1999), and *EPA's Action Development Process: Interim Guidance on Considering Environmental Justice during the Development of an Action* (USEPA 2010).

This section also addresses EO 13045 *Protection of Children from Environmental Health Risks and Safety Risks* issued by President Clinton in 1997. This order addresses concerns that environmental health or safety risks may disproportionately affect children, including products or substances that children are likely to ingest (through breathing, eating, drinking) or with which they may likely come into contact.

### 3.10.2 Existing Conditions

#### 3.10.2.1 Demographic and Social Characteristics

The general socioeconomic effects of the Project would be realized primarily by residents, workers, and businesses within the study area for socioeconomics. As such, it is important to understand the demographic and social characteristics of the affected population. This section describes current and projected population estimates, race and ethnicity (to facilitate the analysis for environmental justice), and economic indicators of social well-being (e.g., unemployment, per capita income, and poverty rates).

## Population

### *Current Population*

Current population estimates are presented in Table 3.10-1. In total, approximately 748,900 people were living in the study area in 2010 (U.S. Census Bureau 2010a). The Project is located in Lancaster County, near the border with Kershaw County to the south. These two counties have estimated populations of 76,700 and 61,700 people, respectively. Within these counties, the largest populations are found in the communities of Lancaster (8,500) and Camden (6,800). Richland County to the south and York County to the north have larger populations. The current population in Richland County is 384,500, and York County has a population of 226,100. The population in the study area represents approximately 16.1 percent of the population base across South Carolina, which was estimated at just over 4.6 million in 2010. In terms of population trends, population in the four-county region has grown at an average annual rate of 2.3 percent between 2000 and 2010.

### *Population Projections*

Five-year population projections through 2030 for the study area are shown in Table 3.10-2. Between 2010 and 2030, population is projected to grow by approximately 1.0 percent annually in the four-county region, increasing from 748,900 in 2010 to 906,600 by 2030 (SCBCB 2012). This population projection is comparable to statewide estimates that show population growing at an annual rate of 0.9 percent in South Carolina. York County is expected to experience the greatest growth relative to the other counties, with its population increasing by approximately 1.4 percent annually during the 30-year projection period. Projected population growth in Lancaster County (0.6 percent annually) is the lowest in the study area.

## Race and Ethnicity

The racial and ethnic composition of the study area is an important factor in understanding whether the Project would result in environmental justice impacts. *Race*, as defined by the U.S. Census Bureau, reflects a social definition of race based on racial and national origin or sociocultural group, and is based on the following categories: White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander. Data are based on self-identification. *Ethnicity*, as another self-identification question asked by the U.S. Census Bureau, refers to whether an individual is from Hispanic or Latino origin (originating from Spanish-speaking countries of Central or South America).The race and ethnicity of the population in the four-county region based on the 2010 census is presented in Table 3.10-3, with local-level data presented for Lancaster County, where the Project would be located. The two largest racial groups are white and black (African American), which comprise 60.1 percent and 33.8 percent of the total population in the four-county region, respectively (U.S. Census Bureau 2010b). All other groups, namely American Indian and Alaska Native, Asian, and Native Hawaiian/Pacific Islander, each account for less than 2 percent of the regional population. Beyond the groups listed above, other races, collectively, represent 1.9 percent of the population; and those identifying themselves as more than one race account for 1.9 percent. The proportion of residents of Hispanic ethnicity living in the four-county region is 4.6 percent, which is less than the statewide average. Generally, the racial/ethnic composition of residents in the four-county region is slightly more diverse than for the state overall.

### Table 3.10-1 Current Population in the Four-County Study Area and State

| Area | Population | | Average Annual Population Change |
|---|---|---|---|
| | 2000 | 2010 | |
| **Lancaster County** | **61,400** | **76,700** | **2.3%** |
| Heath Springs | 860 | 790 | -0.9% |
| Kershaw | 1,600 | 1,800 | 0.9% |
| Lancaster | 8,200 | 8,500 | 0.4% |
| **Kershaw County** | **52,600** | **61,700** | **1.6%** |
| Bethune | 350 | 330 | -0.5% |
| Camden | 6,700 | 6,800 | 0.2% |
| Elgin | 810 | 1,300 | 5.0% |
| **Richland County** | **320,700** | **384,500** | **1.8%** |
| Arcadia Lakes | 880 | 860 | -0.2% |
| Blythewood | 170 | 2,000 | 28.2% |
| Columbia | 116,300 | 129,300 | 1.1% |
| Eastover | 830 | 810 | -0.2% |
| Forest Acres | 10,600 | 10,400 | -0.2% |
| **York County** | **164,600** | **226,100** | **3.2%** |
| Clover | 4,000 | 5,100 | 2.4% |
| Fort Mill | 7,600 | 10,800 | 3.6% |
| Hickory Grove | 340 | 440 | 2.7% |
| McConnells | 290 | 260 | -1.2% |
| Rock Hill | 49,800 | 66,200 | 2.9% |
| Sharon | 420 | 490 | 1.6% |
| Smyrna | 60 | 50 | -2.7% |
| Tega Cay | 4,000 | 7,600 | 6.5% |
| York | 7,000 | 7,700 | 1.0% |
| **Socioeconomics study area** | **599,300** | **748,900** | **2.3%** |
| **South Carolina** | **4,012,000** | **4,625,400** | **1.4%** |

Note:

N/A = not applicable

Sources: U.S. Census Bureau 2000, 2010a.

### Table 3.10-2 Population Projections and Estimated Population Growth in the Four-County Study Area and State (2010–2030)

| Area | 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|
| Lancaster County | 76,700 | 79,100 (0.6%) | 81,400 (0.6%) | 83,900 (0.6%) | 86,000 (0.6%) |
| Kershaw County | 61,700 | 65,400 (1.2%) | 69,200 (1.2%) | 73,000 (1.1%) | 76,500 (1.1%) |
| Richland County | 384,500 | 399,900 (0.8%) | 415,300 (0.8%) | 430,700 (0.8%) | 446,800 (0.8%) |
| York County | 226,100 | 243,600 (1.5%) | 261,000 (1.4%) | 278,500 (1.4%) | 297,300 (1.4%) |
| **Socioeconomics study area** | **748,900** | **788,000 (1.0%)** | **827,000 (1.0%)** | **866,100 (1.0%)** | **906,600 (1.0%)** |
| **South Carolina** | **4,625,400** | **4,864,900 (1.0%)** | **5,104,500 (1.0%)** | **5,344,100 (1.0%)** | **5,580,400 (0.9%)** |

Notes:

Calculated by applying estimated population growth rates between 2010 and 2030 as estimated by the South Carolina Budget and Control Board to 2010 population levels from the 2010 census.

Average annual growth rate relative to year 2010 is shown in parentheses (%).

Sources: U.S. Census Bureau 2010a; SCBCB 2012.

To facilitate the environmental justice analysis, information on race and ethnicity also is presented at the census tract (CT) level within Lancaster County and a selected tract within Kershaw County (adjacent to the Project site). A *census tract* refers to a geographic region defined for the purpose of taking a census, which usually coincides with the limits of cities, towns, or other administrative areas. Overall, the racial composition varies substantially among the census tracts within Lancaster County.

As shown in Table 3.10-3, CT 102 (where the Mine is located) is comparable in diversity across the state. However, it is noted that the Kershaw Correctional Institution is located in CT 102 (adjacent to the Project site) and likely displays higher rates of minority and low-income populations relative to the surrounding region.[1] In addition, several other census tracts in Lancaster County have higher concentrations of minority populations when compared to the statewide patterns. For example, CT 107, which is located within the town of Lancaster, has a high concentration of African-American residents that represent over 80 percent of the total population. Similarly, CT 108 has a high proportion of African-American residents, at 45.1 percent of the total population. Further, the concentration of Hispanics in CT 106 (10.3 percent) is almost twice as high as statewide levels.

[1] Demographic data are not readily available for the Kershaw Correctional Institution specifically. However, data are available for all of the South Carolina Department of Corrections facilities statewide. These data indicate that minority populations account for approximately 67 percent of the inmate population within the state, with 64 percent of the inmate population of African-American race and 3 percent of Other race (South Carolina Department of Corrections 2013).

**Table 3.10-3 Race and Ethnicity in the Four-County Study Area and State (2010)**

| Area | Race (Percent of Total Population) | | | | Ethnicity | | | |
|---|---|---|---|---|---|---|---|---|
| | White | Black | American Indian & Alaska Native | Asian | Native Hawaiian /Pacific Islander | Other Race | Multi-Racial | Hispanic / Latino |
| **Lancaster County** | **71.5%** | **23.8%** | **0.3%** | **0.6%** | **0.0%** | **2.4%** | **1.3%** | **4.4%** |
| Census Tract 101 | 89.1% | 8.7% | 0.4% | 0.2% | 0.0% | 0.5% | 1.1% | 1.1% |
| Census Tract 102 (Haile Gold Mine) | 70.8% | 26.7% | 0.3% | 0.3% | 0.0% | 0.9% | 1.0% | 1.6% |
| Census Tract 103 | 69.4% | 28.5% | 0.3% | 0.2% | 0.0% | 0.6% | 1.1% | 0.9% |
| Census Tract 104 | 60.3% | 36.6% | 0.1% | 0.1% | 0.0% | 1.8% | 1.0% | 3.3% |
| Census Tract 105 | 56.6% | 36.0% | 0.3% | 0.1% | 0.0% | 5.0% | 2.0% | 8.3% |
| Census Tract 106 | 64.7% | 25.3% | 0.1% | 0.1% | 0.0% | 8.1% | 1.5% | 10.3% |
| Census Tract 107 | 17.1% | 80.3% | 0.1% | 0.1% | 0.0% | 1.9% | 0.6% | 3.6% |
| Census Tract 108 | 46.1% | 45.1% | 0.4% | 0.9% | 0.0% | 5.3% | 2.2% | 7.8% |
| Census Tract 109 | 74.0% | 18.0% | 0.3% | 1.9% | 0.0% | 4.7% | 1.1% | 6.5% |
| Census Tract 110.01 | 80.1% | 17.8% | 0.1% | 0.3% | 0.0% | 0.9% | 0.7% | 1.4% |
| Census Tract 110.02 | 81.6% | 15.8% | 0.6% | 0.0% | 0.0% | 1.0% | 1.0% | 2.0% |
| Census Tract 111 | 69.8% | 26.2% | 0.3% | 0.6% | 0.1% | 1.9% | 1.0% | 2.8% |
| Census Tract 112.01 | 85.5% | 7.7% | 0.4% | 1.9% | 0.1% | 2.7% | 1.7% | 8.3% |
| Census Tract 112.02 | 86.5% | 10.1% | 0.4% | 1.0% | 0.0% | 0.8% | 1.3% | 3.5% |
| **Kershaw County** | **71.3%** | **24.6%** | **0.3%** | **0.5%** | **0.0%** | **1.7%** | **1.6%** | **3.7%** |
| Census Tract 9702[a] | 86.1% | 10.8% | 0.4% | 0.0% | 0.0% | 1.2% | 1.4% | 2.6% |
| **Richland County** | **47.3%** | **45.9%** | **0.3%** | **2.2%** | **0.1%** | **1.9%** | **2.2%** | **4.8%** |
| **York County** | **74.8%** | **19.0%** | **0.9%** | **1.5%** | **0.1%** | **1.9%** | **1.8%** | **4.5%** |
| **Socioeconomics study area** | **60.1%** | **33.8%** | **0.5%** | **1.7%** | **0.1%** | **1.9%** | **1.9%** | **4.6%** |
| **South Carolina** | **66.2%** | **27.9%** | **0.4%** | **1.3%** | **0.1%** | **2.5%** | **1.7%** | **5.1%** |

[a] Adjacent to Haile Gold Mine.

Source: U.S. Census Bureau 2010b.

## Economic Indicators of Social Well Being

Table 3.10-4 presents a summary of average annual unemployment, per capita income, and poverty rates within the study area. These parameters provide insights to socioeconomic conditions that characterize the affected population.

**Table 3.10-4 Economic Indicators of Social Well-Being in the Four-County Study Area and State (2006–2010 Annual Average)**

| Area | Unemployment Rate | Per Capita Income | Poverty Rate |
|---|---|---|---|
| **Lancaster County** | **12.3%** | **$19,308** | **20.4%** |
| Census Tract 101 | 10.2% | $18,385 | 14.4% |
| Census Tract 102 (Haile Gold Mine) | 12.5% | $16,009 | 20.8% |
| Census Tract 103 | 9.6% | $17,523 | 24.0% |
| Census Tract 104 | 13.9% | $18,066 | 7.2% |
| Census Tract 105 | 24.4% | $12,180 | 36.3% |
| Census Tract 106 | 10.8% | $16,551 | 22.7% |
| Census Tract 107 | 26.6% | $10,244 | 43.2% |
| Census Tract 108 | 24.7% | $10,187 | 49.3% |
| Census Tract 109 | 12.9% | $27,834 | 10.2% |
| Census Tract 110.01 | 6.5% | $19,926 | 8.8% |
| Census Tract 110.02 | 12.7% | $17,881 | 21.1% |
| Census Tract 111 | 7.5% | $23,013 | 13.8% |
| Census Tract 112.01 | 6.8% | $29,714 | 11.4% |
| Census Tract 112.02 | 9.5% | $25,852 | 13.7% |
| **Kershaw County** | **8.5%** | **$21,777** | **15.5%** |
| Census Tract 9702 (adjacent to Haile Gold Mine) | 16.0% | $16,722 | 22.2% |
| **Richland County** | **8.6%** | **$25,805** | **14.5%** |
| **York County** | **8.9%** | **$25,707** | **12.5%** |
| **Socioeconomics study area** | **9.1%** | **$24,779** | **14.6%** |
| **South Carolina** | **9.3%** | **$23,443** | **16.4%** |

Note: Entries represent 5-year average.

Source: U.S. Census 2010b.

Unemployment within the four-county region averaged 9.1 percent annually between 2006 and 2010, which was slightly less than the statewide average of 9.3 percent for the same period. Unemployment patterns varied among the four counties, with substantially higher unemployment in Lancaster County (12.3 percent) compared to Kershaw, Richland, and York Counties (8.5 to 8.9 percent). Localized unemployment across census tracts in Lancaster County varied considerably, from 6.5 percent in CT 110.01 to 26.6 percent in CT 107. In addition, CT 9702 in Kershaw County exhibits a relatively high unemployment rate—16.0 percent compared to 8.5 percent in the county overall.

Per capita personal income in the four-county region averaged $24,779 annually between 2006 and 2010, which was higher than the statewide figure of $23,443. Lancaster County had the lowest per capita income levels in the study area ($19,308). In that county, per capita income levels were lowest in two census tracts covering the town of Lancaster: CT 108 ($10,187) and CT 107 ($10,244). The income levels in these two census tracts are less than half of the per capita income levels of the four-county region and state overall. In Kershaw County, per capita income in CT 9702 was $16,722, which is lower than countywide, regional, and statewide levels.

*Poverty rates* represent the percentage of an area's total population living at or below the poverty thresholds established by the U.S. Census Bureau; these thresholds represent the dollar amounts the Census Bureau uses to determine a family's or person's poverty status. Overall, the poverty rate in the four-county region averaged 14.6 percent between 2006 and 2010, which is lower than the statewide rate of 16.4 percent; this is consistent with other economic indicators. The poverty rate was highest in CT 108 (49.3 percent), followed closely by CT 107 (43.2 percent) and CT 105 (36.3 percent). Each of these census tracts is located in or near the community of Lancaster. In CT 9702, located in Kershaw County, the poverty rate was 22.2 percent.

### Educational Attainment

The education level of the affected population is another important characteristic of local socioeconomic conditions. Table 3.10-5 presents the educational attainment of local residents in the study area. At the regional level, 86.1 percent of the population in the study area is a high school graduate or higher, which is slightly higher than the statewide rate of 83.0 percent. Similarly, the prevalence of college graduates is also relatively higher; 30.0 percent of the local population has a bachelor degree or higher, compared with 24.0 percent for the state overall.

In Lancaster County, 77.8 percent of the population are high school graduates. In several census tracts in Lancaster County, however, the high school graduation rates are below 70 percent, including CT 105, CT 108, and CT 109. High school graduation rates in CT 9702 in Kershaw County are 71.2 percent, compared to 82.6 percent for the county overall.

## 3.10.3 Regional Economy

This section presents an overview of the regional economy, based primarily on measures of employment and income. In addition, industry-level information is presented to provide an understanding of key industries that support significant sources of jobs and income throughout the state. This information is intended to provide a general understanding of the economic climate characterizing the region and to put into perspective the effect of proposed mining operations on local economic conditions.

### Employment and Major Industries

Employment patterns provide important insights into the size, strength, and diversity of a local economy. Total employment and employment by industry across the study area and the State of South Carolina are presented in Tables 3.10-6a and 3.10-6b. In total, there were approximately 417,000 part- and full-time jobs in the four-county region and nearly 2.5 million jobs in South Carolina in 2009 (Bureau of Economic Analysis 2012a). Generally, employment within the four-county region is concentrated in Richland and York Counties. Employment levels in Lancaster and Kershaw Counties are comparable at 24,700 and 26,300 jobs, respectively. The largest sectors in the regional economy (based on the number of jobs) were Other Industries (including a wide range of industry sectors listed in Table 3.10-6a and 3.10-6b), Government (including local, state, and federal), and Wholesale/Retail Trade. The Wholesale Trade sector comprises establishments engaged in wholesaling merchandise, primarily the sale of goods for resale, and is considered an intermediate step in the distribution of merchandise. The Retail Trade sector comprises establishments engaged in selling merchandise to the general public.

### Table 3.10-5 Educational Attainment in the Four-County Study Area and State (2006–2010 Annual Average)

| Area | High School (%) | Bachelor Degree or Higher (%) |
|---|---|---|
| **Lancaster County** | **77.8%** | **15.4%** |
| Census Tract 101 | 73.3% | 7.8% |
| Census Tract 102 (Haile Gold Mine) | 71.8% | 8.5% |
| Census Tract 103 | 78.3% | 11.4% |
| Census Tract 104 | 77.8% | 7.9% |
| Census Tract 105 | 62.1% | 3.8% |
| Census Tract 106 | 79.2% | 11.2% |
| Census Tract 107 | 76.0% | 9.4% |
| Census Tract 108 | 66.2% | 2.8% |
| Census Tract 109 | 67.0% | 11.3% |
| Census Tract 110.01 | 79.6% | 9.7% |
| Census Tract 110.02 | 88.6% | 33.8% |
| Census Tract 111 | 80.8% | 18.6% |
| Census Tract 112.01 | 87.6% | 33.1% |
| Census Tract 112.02 | 88.3% | 30.9% |
| **Kershaw County** | **82.6%** | **18.5%** |
| Census Tract 9702 (adjacent to Haile Gold Mine) | 71.2% | 5.3% |
| **Richland County** | **88.4%** | **36.5%** |
| **York County** | **85.9%** | **26.9%** |
| **Socioeconomics study area** | **86.1%** | **30.0%** |
| **South Carolina** | **83.0%** | **24.0%** |

Note: Data are for population 25 years old and over.

Source: U.S. Census 2010c.

## Table 3.10-6a Employment by Industry in the Four-County Study Area (2001 and 2009)

| Industry [a] | Kershaw County | | Lancaster County | | Richland County | | York County | |
|---|---|---|---|---|---|---|---|---|
| | 2001 | 2009 | 2001 | 2009 | 2001 | 2009 | 2001 | 2009 |
| Farm / agriculture | 618 | 559 | 703 | 562 | 445 | 382 | 1,052 | 1,395 |
| Natural resource and mining | 264* | 393 | 143 | (D) | 412 | 644 | 246 | 237 |
| Construction | 2,308 | 2,145 | 1,638 | 1,401 | 11,261 | 9,750 | 5,075 | 5,014 |
| Manufacturing | 4,810 | 3,219 | 6,050 | 2,255 | 13,201 | 10,808 | 10,915 | 9,117 |
| Wholesale and retail trade | 3,036 | 3,434 | 2,830* | 3,299 | 32,674 | 32,368 | 13,927 | 15,826 |
| Transportation and warehousing | 882 | 705 | 440 | (D) | 2,649 | 2,782 | (D) | 2,305 |
| Utilities | 37 | 42 | (D) | (D) | 2,027 | 2,274 | (D) | 1,433 |
| Information | 137 | 382 | 219 | 264 | 6,355 | 9,219 | 1,934 | 3,339 |
| Finance and insurance | 952 | 1,332 | 1,229 | 1,411 | 6,556 | 5,395 | (D) | 1,872 |
| Other services [b] | 5,919* | 10,192 | 5,153* | 9,236* | 111,222 | 124,450 | 26,300* | 47,087 |
| Government | 3,514 | 3,859 | 3,993 | 4,197 | 68,790 | 67,275 | 10,873 | 12,965 |
| **Total** | **24,064** | **26,262** | **25,358** | **24,697** | **255,814** | **265,535** | **77,594** | **100,668** |

Notes:

* Does not represent actual total due to missing estimates for counties avoiding disclosure of confidential information; estimate included in segment and state totals.

(D) Not shown to avoid disclosure of confidential information, but estimates are included in the total.

[a] Industry groups are based on an aggregation of North American Industry Classification System industry classifications.

[b] "Other services" includes Real Estate and Leasing; Professional; Professional, Scientific, and Technical Services; Management of Companies and Enterprises; Administrative and Waste Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; and Other Services except Public Administration.

Source: Bureau of Economic Analysis 2012a.

## Table 3.10-6b Employment by Industry in the Study Area and State (2001 and 2009)

| Industry[a] | Socioeconomics Study Area | | South Carolina | |
|---|---|---|---|---|
| | 2001 | 2009 | 2001 | 2009 |
| Farm / agriculture | 2,818 | 2,898 | 32,461 | 30,396 |
| Natural resource and mining | 1,065* | 1,274* | 12,827 | 13,329 |
| Construction | 20,282 | 18,310 | 152,634 | 141,211 |
| Manufacturing | 34,976 | 25,399 | 318,781 | 222,143 |
| Wholesale and retail trade | 52,467* | 54,927 | 333,634 | 343,290 |
| Transportation and warehousing | 3,971* | 5,792* | 60,513 | 62,668 |
| Utilities | 2,064* | 3,749* | 12,488 | 12,810 |
| Information | 8,645 | 13,204 | 33,057 | 32,668 |
| Finance and insurance | 8,737* | 10,010 | 77,714 | 106,185 |
| Other services [b] | 148,594* | 190,965* | 831,723 | 1,091,646 |
| Government | 87,170 | 88,296 | 377,827 | 402,245 |
| **Total** | **382,830** | **417,162** | **2,243,659** | **2,458,591** |

Notes:

* Does not represent actual total due to missing estimates for counties avoiding disclosure of confidential information; estimate included in segment and state totals.

(D) Not shown to avoid disclosure of confidential information, but estimates are included in the total.

[a] Industry groups are based on an aggregation of North American Industry Classification System industry classifications.

[b] "Other services" includes Real Estate and Leasing; Professional; Professional, Scientific, and Technical Services; Management of Companies and Enterprises; Administrative and Waste Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; and Other Services except Public Administration.

Source: Bureau of Economic Analysis 2012a.

Based on employment levels, the economy in the four-county region is dependent on these leading sectors, which account for over 80 percent of the regional job base. In addition, the regional economy has transitioned away from local manufacturing, where jobs declined by 27 percent between 2001 and 2009. The Natural Resources and Mining sector accounts for a relatively small proportion (less than 1 percent) of total employment in the four-county region and the state.

The economic base within the local area also is influenced by key employers that provide large numbers of jobs to local residents in Lancaster and Kershaw Counties. Major sources of private employment in Lancaster County include the following companies (Lancaster County Economic Development Corporation 2012):

- Red Ventures – internet marketing and sales company (813 employees);
- Cardinal Health – global healthcare product and service company, and surgical kit manufacturer (600 employees);
- Spring Memorial Hospital – private acute care hospital (584 employees);
- Duracell USA – manufacturer of alkali batteries (405 employees); and
- Continental Tire – tire manufacturing (400 employees).

In Kershaw County, private employers that support the greatest number of jobs include (Kershaw County Economic Development Office 2012):[2]

- Kershaw Health – medical and health services throughout Kershaw County (1,104 employees);
- Target Corporation – includes a 1.8-million square-foot regional distribution center located in Lugoff (580 employees);
- UTI – contractual employer located in Lugoff (320 employees);
- Wal-Mart – retail stores (300 employees);
- Haier American Refrigerator – refrigerator manufacturing company located in Camden (225 employees); and
- Hengst – manufacturer of automotive filters (241 employees).

The top employers referenced above account for approximately 11 percent of the total employment base in both Lancaster and Kershaw Counties, respectively.

### Earnings and Income

Tables 3.10-7a and 3.10-7b present earnings by industry (a component of total personal income) in the study area and state in 2009. The measure of earnings by industry is more relevant than total personal income in evaluating the potential impacts of changes in gold mining on the local economy because it focuses on wages/salaries of employees and proprietor’s (business) income and excludes other factors such as transfer payments, which are unlikely to be affected by the Project. Total earnings in the four-county region were $19.1 billion in 2009, while earnings throughout South Carolina totaled approximately $99.9 billion. Earnings associated with employment in Other Industries was highest when

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[2] Excludes Kershaw County School District employment (1,441 employees) and County government employment 250 employees).

compared to all sectors within the four-county region, followed closely by the Government sector. Similar to employment patterns, the Natural Resources and Mining sector generates relatively limited employment earnings.

### 3.10.3.1 Fiscal Resources

The Project would generate various tax revenues at both the local and state level. To provide context, Table 3.10-8 summarizes municipal tax and other revenues collected and/or allocated to state and local governments within the study area in fiscal year (FY) 2010.[3] Revenue sources include sales and use taxes, individual income taxes, corporate income taxes, property taxes, other revenue sources, and payments from state and federal sources. More information on each of these revenue sources is provided in the following subsections. Because the tax revenue generated by the Project would accrue primarily to Lancaster County, it is the focus of the discussion below.

#### Sales and Use Tax

The sales/use tax rate in South Carolina is 5 percent. Thirty-one counties in South Carolina impose an additional 1 percent local option sales/use tax, including Kershaw and Lancaster Counties. This additional tax levy is imposed to reduce the property tax burden on county residents and is collected by the South Carolina Department of Revenue on behalf of the counties. Counties and cities also may impose local sales/use taxes for road improvements, capital projects, schools, and other purposes—with revenues used to defray the debt service on bonds issued for these purposes. Eleven counties in South Carolina implement local option sales/use tax for capital improvements, including Lancaster County.

As illustrated in Table 3.10-8, the total sales/use tax accruing to the State General Fund in 2010 was nearly $2.2 billion. Lancaster County realized $8.2 million in sales/use tax revenues that same year, and the municipalities within Lancaster County accrued a total of $2.6 million. There were no direct sales tax collections from the metal mining sector in South Carolina in FY 2009–2010; however, mining activities could indirectly generate sale tax revenues through purchases of local materials and equipment (SCDOR 2010).

#### Income Tax

The two types of income taxes in South Carolina are individual and corporate income taxes. The individual income tax rate varies from 0 to 7 percent; the corporate tax rate in South Carolina is 5 percent of net corporate income. As shown in Table 3.10-8, total individual income tax collected by the State in 2010 was almost $2.2 billion, and a total of $109.6 million in corporate income taxes was collected (SCDOR 2010). Public information on income taxes is not available at the industry level.

[3] FY 2010 extends from July 1, 2009, to June 30, 2010.

**Table 3.10-7a Earnings by Industry in the Four-County Study Area ($ thousands) (2001 and 2009)**

| | Kershaw County | | Lancaster County | | Richland County | | York County | |
|---|---|---|---|---|---|---|---|---|
| Industry [a] | 2001 | 2009 | 2001 | 2009 | 2001 | 2009 | 2001 | 2009 |
| Farm / agriculture | $12,828 | $29,725 | $14,574 | $5,169 | $2,991 | $1,921 | $28,663 | $39,807 |
| Natural resource and mining | $7,245* | $10,835 | $4,598 | (D) | $20,935 | $28,264 | $7,788 | $7,908 |
| Construction | $82,476 | $73,135 | $62,540 | $42,874 | $476,404 | $500,129 | $163,412 | $185,099 |
| Manufacturing | $258,652 | $202,803 | $278,298 | $145,480 | $642,187 | $763,426 | $546,074 | $582,071 |
| Wholesale and retail Trade | $60,630 | $100,787 | $60,549* | $89,711 | $1,146,426 | $1,363,326 | $454,451 | $657,391 |
| Transportation and warehousing | $27,545 | $22,023 | $12,087 | (D) | $102,815 | $124,080 | (D) | $78,352 |
| Utilities | $2,016 | $2,705 | (D) | (D) | $149,325 | $224,552 | (D) | $178,039 |
| Information | $3,603 | $27,270 | $8,290 | $16,261 | $348,681 | $384,922 | (D) | $147,164 |
| Finance and insurance | $31,900 | $55,483 | $44,105 | $51,497 | $912,753 | $1,197,874 | $70,036 | $339,237 |
| Other services [b] | $108,290* | $207,897 | $84,330* | $229,796* | $3,049,794 | $4,228,572 | $673,227* | $1,218,951 |
| Government | $121,145 | $195,701 | $134,846 | $190,704 | $2,925,465 | $4,422,575 | $388,193 | $659,144 |
| **Total** | **$754,499** | **$928,364** | **$812,549** | **$838,920** | **$9,777,776** | **$13,239,641** | **$2,743,998** | **$4,093,163** |

Notes:

* Does not represent actual total due to missing estimates for counties avoiding disclosure of confidential information; estimate included in segment and state totals.

(D) Not shown to avoid disclosure of confidential information, but estimates are included in the total.

[a] Industry groups are based on an aggregation of North American Industry Classification System industry classifications.

[b] "Other services" includes Real Estate and Leasing; Professional; Professional, Scientific, and Technical Services; Management of Companies and Enterprises; Administrative and Waste Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; and Other Services except Public Administration.

Source: Bureau of Economic Analysis 2012b.

### Table 3.10-7b Earnings by Industry in the Study Area and State ($ thousands) (2001 and 2009)

| Industry [a] | Socioeconomics Study Area | | South Carolina | |
|---|---|---|---|---|
| | 2001 | 2009 | 2001 | 2009 |
| Farm / agriculture | $59,056 | $76,622 | $646,900 | $506,138 |
| Natural resource and mining | $40,746* | $47,007* | $398,381 | $397,471 |
| Construction | $784,832 | $801,237 | $5,822,579 | $5,854,227 |
| Manufacturing | $1,725,211 | $1,693,780 | $14,339,410 | $13,555,536 |
| Wholesale and retail trade | $1,722,256* | $2,211,215 | $9,686,502 | $11,987,588 |
| Transportation and warehousing | $142,447* | $224,455* | $2,302,064 | $2,653,258 |
| Utilities | $151,341* | $405,296* | $923,267 | $1,308,702 |
| Information | $360,574* | $575,617 | $1,457,023 | $1,933,736 |
| Finance and insurance | $1,058,794 | $1,644,091 | $3,362,093 | $5,207,515 |
| Other services [b] | $3,915,641* | $5,885,215* | $22,698,541 | $32,749,429 |
| Government | $3,569,649 | $5,468,124 | $15,228,734 | $23,770,580 |
| **Total** | **$14,088,822** | **$19,100,088** | **$76,865,494** | **$99,924,180** |

Notes:

* Does not represent actual total due to missing estimates for counties avoiding disclosure of confidential information; estimate included in segment and state totals.

(D) Not shown to avoid disclosure of confidential information, but estimates are included in the total.

[a] Industry groups are based on an aggregation of North American Industry Classification System industry classifications.

[b] "Other services" includes Real Estate and Leasing; Professional; Professional, Scientific, and Technical Services; Management of Companies and Enterprises; Administrative and Waste Services; Educational Services; Health Care and Social Assistance; Arts, Entertainment, and Recreation; Accommodation and Food Services; and Other Services except Public Administration.

Source: Bureau of Economic Analysis 2012b.

**Table 3.10-8 Tax and Other Public Revenues in the Four-County Study Area and State ($ millions) (Fiscal Year 2010)**

| Jurisdiction | Sales and Use Tax[a] | Individual Income Tax | Corporate Income Tax | Property Taxes | Other Revenue[b] | Payment from State and Federal Sources | Total Revenues |
|---|---|---|---|---|---|---|---|
| **Lancaster County (all)** | **$10.8 (6.2%)** | **N/A** | **N/A** | **$56.4 (32.2%)** | **$29.4 (13.8%)** | **$83.8 (47.9%)** | **$175.1** |
| School District | N/A | N/A | N/A | $32.8 (28.9%) | $6.5 (5.7%) | $74.3 (65.4%) | $113.6 |
| County | $8.2 (17.4%) | N/A | N/A | $19.5 (41.6%) | $16.8 (24.5%) | $7.7 (16.4%) | $46.9 |
| Cities[c] | $2.6 (18.0%) | N/A | N/A | $4.0 (27.7%) | $6.1 (41.6%) | $1.9 (12.7%) | $14.6 |
| **Kershaw County (all)** | **$5.1 (3.5%)** | **N/A** | **N/A** | **$46.4 (31.8%)** | **$23.6 (16.1%)** | **$71.0 (48.6%)** | **$146.1** |
| School District | N/A | N/A | N/A | $32.4 (29.5%) | $14.2 (12.9%) | $63.3 (57.6%) | $110.0 |
| County | $3.1 (11.3%) | N/A | N/A | $12.8 (47.0%) | $4.5 (16.6%) | $6.8 (25.1%) | $27.2 |
| Cities[d] | $2.0 (22.5%) | N/A | N/A | $1.2 (13.8%) | $4.8 (54.0%) | $0.9 (9.6%) | $9.0 |
| **Richland County (all)** | **$61.1 (5.1%)** | **N/A** | **N/A** | **$433.3 (36.5%)** | **$310.1 (26.1%)** | **$382.6 (32.2%)** | **$1,187.2** |
| School District | N/A | N/A | N/A | $317.1 (40.9%) | $130.1 (16.8%) | $327.9 (42.3%) | $775.1 |
| County | $33.3 (14.2%) | N/A | N/A | $83.7 (35.7%) | $84.9 (36.3%) | $32.3 (13.8%) | $234.2 |
| Cities[e] | $27.8 (15.7%) | N/A | N/A | $32.5 (18.3%) | $95.1 (53.5%) | $22.4 (12.6%) | $177.9 |
| **York County (all)** | **$29.9 (3.6%)** | **N/A** | **N/A** | **$267.2 (32.0%)** | **$280.4 (33.5%)** | **$258.7 (30.9%)** | **$836.2** |
| School District | N/A | N/A | N/A | $166.9 (27.0%) | $220.9 (35.8%) | $229.2 (37.2%) | $617.1 |
| County | $25.6 (18.9%) | N/A | N/A | $67.5 (49.7%) | $22.0 (16.2%) | $20.5 (15.1%) | $135.6 |
| Cities[f] | $4.2 (5.0%) | N/A | N/A | $32.9 (39.4%) | $37.5 (44.9%) | $8.9 (10.7%) | $83.5 |

**Table 3.10-8 Tax and Other Public Revenues in the Four-County Study Area and State ($ millions) (Fiscal Year 2010) (Continued)**

| Jurisdiction | Sales and Use Tax[a] | Individual Income Tax | Corporate Income Tax | Property Taxes | Other Revenue[b] | Payment from State and Federal Sources | Total Revenues |
|---|---|---|---|---|---|---|---|
| **State of South Carolina (general fund revenues)** | **$2,181.1 (45.1%)** | **$2,167.1 (44.8%)** | **$109.6 (2.3%)** | **N/A** | **$379.7 (7.8%)** | **N/A** | **$4,837.6** |

Notes:

N/A = not applicable

Numbers in parentheses represent percentage of total revenues for that jurisdiction.

a Sales and use tax includes casual excise tax, local option sales tax, local option sales tax for capital projects, hospitality tax, and accommodations tax.

b Other revenue for counties include licenses, fees, charges, and bonds.

c Lancaster County cities included in the results are Heath Springs, Kershaw, and Lancaster.

d Kershaw County cities included in the results are Bethune, Camden, and Elgin.

e Richland County cities included in the results are Arcadia Lakes, Blythewood, Columbia, Eastover, and Forest Acres.

f York County cities included in the results are Clover, Fort Mill, Hickory Grove, McConnells, Rock Hill, Sharon, Smyrna, Tega Cay, and York.

Sources: SCDOR 2010; SCBCB 2011.

### Property Tax

Counties, cities, and school districts are authorized to impose property taxes on real and personal property in South Carolina. The property tax is administered and collected by local governments, with assistance from the South Carolina Department of Revenue. Approximately two-thirds of county-levied property taxes are used for support of public education (SCDOR 2012). County-wide property tax collections totaled $56.4 million in Lancaster County for FY 2010 (SCBCB 2011). Incorporated municipalities and county governments also receive property tax revenues. Within Lancaster County, municipalities realized approximately $4.0 million in property tax revenues, and $19.5 million was allocated to the county itself. (More information on Haile's contribution to property taxes is provided in Section 3.10.2.)

### Other Public Revenue

Other sources of public revenues for local counties and municipalities include licenses, permits, service revenues, charges, bonds, leases, and miscellaneous revenues. Revenues from these other sources totaled $29.4 million in Lancaster County during FY 2010 (SCBCB 2011). At the state level, other tax revenues also include aircraft taxes, alcohol tax, bank tax, bingo tax, corporation license tax, and miscellaneous other sources. In FY 2010, the State collected approximately $379.7 million in other revenues (SCDOR 2010). These other public revenues are not affected to a large extent by mining activity in the state.

### Payments from State and Federal Sources

Local counties, school districts, and municipalities also receive revenues directly from the state and federal governments. State revenue sources include reimbursement of property tax relief, homestead exemption, aid to subdivisions, manufacturer depreciation reimbursement, state grants, the Education

Finance Act, the Education Improvement Act, and the Education Lottery. Revenues from federal sources include Community Development Block Grants, Department of Justice Grants, Economic Development Grants, and other miscellaneous federal grants. Collectively, Lancaster County received $83.8 million in payments from state and federal sources in FY 2010 (SCBCB 2012). School districts were the largest recipients of these funds, accounting for 89 percent of the total distributed within each county. Payments from state and federal sources are largely unaffected by mining activity within the state.

### 3.10.3.2 Housing Resources

Local housing resources would be used to serve mine employees during mine development and operations. The Project also may affect local property values. Information on housing availability and property values is presented below.

#### Housing Stock

Information on the local housing stock is presented in Table 3.10-9. Approximately 316,100 housing units were present in the four-county region in 2010, with approximately 32,700 units in Lancaster County and 27,500 units in Kershaw County (U.S. Census Bureau 2010a). The vacancy rate across all units was approximately 9.9 percent, which was substantially lower than the statewide vacancy rate of 15.7 percent. At the local level, the vacancy rate in the nearby community of Kershaw was 12.6 percent. Within Lancaster and Kershaw Counties, there were approximately 6,540 vacant housing units.

**Table 3.10-9 Local Housing Resources in the Four-County Study Area and State (2010)**

| Area | Housing Units | Occupied | Vacant | Vacancy Rate |
|---|---|---|---|---|
| **Lancaster County** | **32,687** | **29,697** | **2,990** | **9.1%** |
| Heath Springs | 375 | 327 | 48 | 12.8% |
| Kershaw | 851 | 744 | 107 | 12.6% |
| Lancaster | 3,981 | 3,510 | 471 | 11.8% |
| **Kershaw County** | **27,478** | **23,928** | **3,550** | **12.9%** |
| **Richland County** | **161,725** | **145,194** | **16,531** | **10.2%** |
| **York County** | **94,196** | **85,864** | **8,332** | **8.8%** |
| **Socioeconomic study area** | **316,086** | **284,683** | **31,403** | **9.9%** |
| **South Carolina** | **2,137,683** | **1,801,181** | **336,502** | **15.7%** |

Source: U.S. Census Bureau 2010a.

#### Temporary Housing

Temporary housing, including local motels/hotels and apartments, also would likely be used to accommodate mine employees. In total, approximately 23 hotels/motels are within 25 miles of the Project boundary, including 12 in Camden (304 rooms), six in Lancaster (213 rooms), four in Lugoff (248 rooms), and one in Kershaw (45 rooms) (Haile 2012b). In total, approximately 810 hotel/motel rooms are in the region. In addition, approximately 21 apartment complexes could serve the Project. Information on vacancy rates across temporary housing options varies. In 2011, the average hotel occupancy rate was 57.8 percent (SCDPRT 2012); applying this rate to the number of local hotel/motel rooms yields an estimated average of 342 vacant rooms in proximity to the Project. For apartment units, the vacancy rate in the Columbia Housing Market Area (which includes Kershaw County) was approximately 10 percent in 2011 (HUD 2011).

### Property Values

The Project could affect property values in the local area. The nearest community is the Town of Kershaw. In Kershaw, the estimated median house or condominium value in 2009 was $91,773—up from $65,200 in 2000 but lower than the statewide median value of $137,500. The median gross rent in 2009 for all rental property was $611 (City-Data.com 2012).

## 3.10.3.3 Public Services and Community Infrastructure

The Project would place demands on local public services and community infrastructure. This section provides information on the following services: education and schools, solid waste disposal, and utilities. Sections 3.18 and 4.18, "Health and Safety" address law enforcement, fire protection and emergency services, and medical aid; Sections 3.12 and 4.12, "Transportation" discuss road maintenance requirements.

### Education and Schools

Educational services within Lancaster County are provided by the Lancaster County School District. The District serves grades pre-kindergarten through adult education. Total enrollment in the District in 2011 was 11,928 students, which were served by 884 teachers (Lancaster County School District 2012a). The District has 10 elementary schools, five middle schools, and four high schools (Lancaster County School District 2012b).

### Solid Waste Disposal

As a commercial operation, the Project must contract for solid waste disposal with commercial haulers in the region (LCPWD 2012). It is likely that commercial haulers would use the same landfill sites that Lancaster County uses to handle its residential solid waste, which includes the Lee County Landfill (Permit Number 312411-1101) and Mining Road Landfill (Permit Number 292440-1601). The Lee County Landfill, located in Bishopville, South Carolina, is a Class 3 facility. These facilities are designed to accept municipal solid waste and certain types of industrial solid waste. In terms of capacity, this landfill has an expected life of 15 to 17 years (SCDHEC 2012). The Mining Road landfill, located in Kershaw, is a Class 2 facility. These facilities are designed to accept construction and demolition waste and some types of industrial solid waste.[4]

### Utilities

The core utilities that would be required for mining operations are water supply, wastewater disposal, and electrical power.

#### *Water Supply and Wastewater Disposal*

The Project would be served by public water and wastewater systems. Specifically, water and sewer services would be provided by the LCW&SD. LCW&SD serves residential, commercial, and industrial customers across approximately 90 percent of Lancaster County (LCW&SD 2012). It also provides wholesale water service to the City of Lancaster, Town of Heath Springs, Town of Kershaw, and the Carolina Water Service.

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[4] Information on the life expectancy of the Mining Road Landfill is not readily available.

Public water supplies provided by LCW&SD come from the Catawba River Water Supply Project, also known as the Catawba River Water Treatment Facility (CRWTF). CRWTF began providing water for LCW&SD in 1993, with a capacity of 18 million gallons per day (MGD). In 2003, the capacity of this facility was expanded to 36 MGD to meet the future water supply needs of the region (LCW&SD 2012).

Wastewater service provided by LCW&SD is supported by various agreements with and facilities of local municipalities. Near the City of Lancaster, all wastewater south of Highway 5 is collected by LCW&SD and treated by the City of Lancaster's Wastewater Treatment Plant (LCW&SD 2012). The new facilities for the Project would be connected to the Town of Kershaw municipal waste water treatment facility (Haile 2013).

#### *Electrical Power*

Duke Energy would provide electrical power to the Project site. Duke has provided Haile Gold Mine with a letter of intent to provide the Haile operations with a 69 KV service (Haile 2012b).

### 3.10.3.4 Overview of the Metal Ore and Gold Mining Industries

The core purpose of developing and operating Haile Gold Mine is the extraction and production of gold. This section provides a general overview of the types and magnitude of regional economic benefits associated with mining activity. Section 3.10.2.7 builds on this discussion by focusing on the economic conditions attributed specifically to existing activities at Haile Gold Mine. More general information on the gold industry, including the supply and demand for gold and market trends, is presented in Section 1.5, "Project Purpose and Need."

#### Economic Benefits of Metal Ore Mining

The production of metal ore (which includes gold) provides an array of economic benefits at the national level and in producing states. In this section, the focus is on the economic benefits of metal mining collectively, including the contribution to employment, income parameters, and gross domestic product (GDP). *GDP* is the market value of all officially recognized final goods and services produced within a country in a given period; it is also referred to as *value added*.

These benefits are attributed not only to direct production of metal ore, including the value of the commodity produced and employment and income supported at the mine site, but also to inter-industry linkages implicit in the production process. Specifically, the total economic impact of the metal mining industry accounts for the subsequent economic activity generated by its operational expenditures in support of mining activity. This consists of *indirect economic effects*, which refer to changes in output, income, and employment resulting from the iterations of businesses in some industries purchasing from businesses in other industries. These effects are initially caused by the direct economic effects. The total economic impact also captures the re-spending of labor income by households, or induced effects. *Induced effects* refers to changes in output, income, and employment caused by the expenditures associated with the new household income generated by direct and indirect economic effects.

The metal mining industry produces primary inputs serving many other industries across the national and regional economies, such as jewelry and other manufacturing, thereby supporting additional economic activity. The contribution of metal mining to the intermediate and final products of these industries is noted here (*forward-linkages*, which occur when the products of one industry are used as the raw materials of another industry) but is not included in the benefit estimates presented in this section.

The total benefits of the metal mining industry are based on the *multiplier* effect. This effect refers to the process where an increase in spending produces an increase in income and consumption greater than the initial amount spent. The multiplier effect accounts for the additional economic activity generated through inter-industry purchases and household spending. For example, production of a million dollars of agricultural commodities may directly support 100 jobs at the farm level but may support an additional 20 jobs in the agricultural support industries, which provide farm inputs such as seed and fertilizer, as a result of agricultural workers spending their labor earnings in the local economy.

As shown in Table 3.10-10, the direct contribution of metal ore production to the national GDP was an estimated $19.1 billion in 2008. In addition, this industry supports just over 88,000 direct jobs nationally, with associated labor income of $7.3 billion. Estimates of the direct employment benefits at gold mines in the United States (at the mine and Mill only) have steadily increased from 9,130 jobs in 2007 to 10,300 jobs in 2011 (USGS 2012). However, accounting for indirect and induced effects, the metal mining industry supports an annual total contribution of approximately $37.2 billion to the national economy (GDP), 289,000 jobs, and $18.1 billion in total labor income across all sectors of the economy.

**Table 3.10-10 Economic Benefits of the Metal Mining Industry to the U.S. and South Carolina Economy ($ millions) (2008)**

| Area | GDP Contribution | | Labor Income | | Employment | |
|---|---|---|---|---|---|---|
| | Direct[a] | Total | Direct[a] | Total | Direct[a] | Total |
| United States | $19,060 | $37,205 | $7,287 | $18,094 | 88,090 | 289,360 |
| South Carolina | $7 | $105 | $3 | $62 | 40 | 1,320 |

[a] Direct effects include mining, support activities for mining, and transportation of minerals from mines to customers.

Source: National Mining Association 2010.

The metal mining industry in South Carolina also contributes substantially to the state economy. Specifically, the total contribution of metal mining to the South Carolina economy was approximately $105 million in 2008. In addition, the metal mining industry in the state supported 1,320 jobs and $62 million in total income. Information on the economic benefits of gold production within South Carolina is not available. Beyond gold production, however, the larger mining industry in South Carolina supports approximately 485 active mines, with an estimated raw mineral production value at the lip of the mine of approximately $483 million annually, which ranks it 25th in the United States for the total value of mineral production (Mining Association of South Carolina 2012).

### 3.10.3.5 Existing Economic Effects from Haile Gold Mine

Ongoing activities at Haile Gold Mine continue to generate a range of economic benefits to the region and state while permits and regulatory approvals are being sought. Currently, the principal activity at the mine is exploratory drilling, which is supported by a range of administrative functions.

#### Project Spending and Employment

The economic activity associated with ongoing activities at Haile Gold Mine is attributed to Project spending on equipment, materials, and services, as well as employment and labor income for mine employees. Economic benefits generated by the Project began in 2007 and continue under existing conditions. Since 2007, Haile has acquired drilling equipment and built a new laboratory facility to facilitate exploratory activities. The cumulative spending over this 5-year period (2007–2011) was approximately $201.2 million, the largest components of which were land purchases ($77.3 million) and drilling ($49.8 million) (Haile Gold Mine 2012b). Over this same period, employment supported by Haile Gold Mine has increased from four employees in 2007 to 115 employees by the end of 2011. Most of this gain is attributed to exploration activities. In 2012, Haile conducted exploration activities at a cost of approximately $1 million per month, which included site preparation and reclamation costs; operating and maintenance costs; sample preparation, geology, and assay costs; environmental costs for the drill program; and overhead.

The role of the ongoing activities at Haile Gold Mine extend outside the mine to the regional and statewide economies. These broader economic benefits are attributed to Project and employee spending that filters through inter-industry linkages, generating additional business production, income, and jobs in a wide range of industries that support the Project. The magnitude of these benefits to Lancaster County, other counties throughout the state, and South Carolina as a whole depend on where Project spending is occurring and the ability of local industries to meet the demands of the Project.

#### Tax Benefits Supported by Haile Gold Mine

Currently, Haile pays property taxes on lands within the Project boundary, which includes parcels covered by the fee-in-lieu-of-tax (FILOT) agreement with Lancaster County and parcels that are excluded from the FILOT agreement. Property taxes are paid on miscellaneous equipment and other taxable property. In total, approximately 6,031 acres are included in the FILOT agreement, and an additional 4,101 acres are excluded. Overall, property tax payments total approximately $707,000 annually under existing conditions, including $555,000 for property included in the FILOT agreement and $152,000 for other non-FILOT lands (Haile 2012b).

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# 3.11 Land Use

*Land use* represents the economic and cultural activities that are practiced at a place, such as agricultural, residential, industrial, mining, and recreational uses (USEPA 2013). Proposed mining and reclamation activities would have both short-term and long-term effects on existing and future land use. Land use issues of concern include changes in land use and land ownership, consistency with local zoning ordinances, and potential impacts on prime and unique farmlands.

This section describes the state and local land use regulations that pertain to the Project and the existing conditions relative to land use, land ownership, Project area zoning, and prime and unique farmlands. Section 4.11 describes the potential effects of the Project on land use within the study area.

The study area for land use includes the geographic area within which the direct and indirect Project-related effects on land use can be identified and analyzed. This includes the Project area (the area within the Project boundary) and surrounding unincorporated areas in Lancaster and Kershaw Counties (see Figure 3.11-1).

## 3.11.1 Regulatory Setting

The following text focuses on requirements specific to land use. Appendix F contains further details on regulations that apply to the Project.

The Project is on private land owned or controlled by Haile (M3 Engineering & Technology Corporation 2010). No federal lands are located within or adjacent to the Project area; consequently, no applicable federal land management plan is associated with the Project area or the adjacent land parcels (National Atlas 2012).

### 3.11.1.1 South Carolina Mining Act

The Haile Gold Mine has been previously mined under Permit No. I-601, Permit No. I-214 (Hilltop Pits), and Permit No. I-440 (Parker Pit); these permits were issued by the SCDHEC, as required by the South Carolina Mining Act (SCMA) (SCDHEC 2012). In South Carolina, mining permits are issued by SCDHEC's Bureau of Land and Waste Management. All permitted mining operations must comply with the 1974 SCMA. The SC Mining and Reclamation Program enforces the SCMA. This includes issuing permits, reviewing and approving reclamation plans, collecting reclamation performance bonds, conducting environmental appraisals, providing technical assistance to mine operators and the public, implementing research and demonstration projects, and inspecting all mining operations and reclamation. The Mining Council is the advisory body that considers issues relating to mining, including mining-related appeals, and enforcement of the Mining Act.

### 3.11.1.2 Lancaster County Regulations

The Project area is located completely within Lancaster County, South Carolina. The Lancaster County Planning Department oversees all county planning activities, including writing regulations for development and advising on re-zoning applications and appeals. The Lancaster County Planning Commission reviews and makes recommendations to the Lancaster County Council on rezoning applications and any changes to the text of the zoning or subdivision regulations. The Lancaster County Council is elected by the residents of the County and sets the overall policy for the County (Lancaster County 2012a).

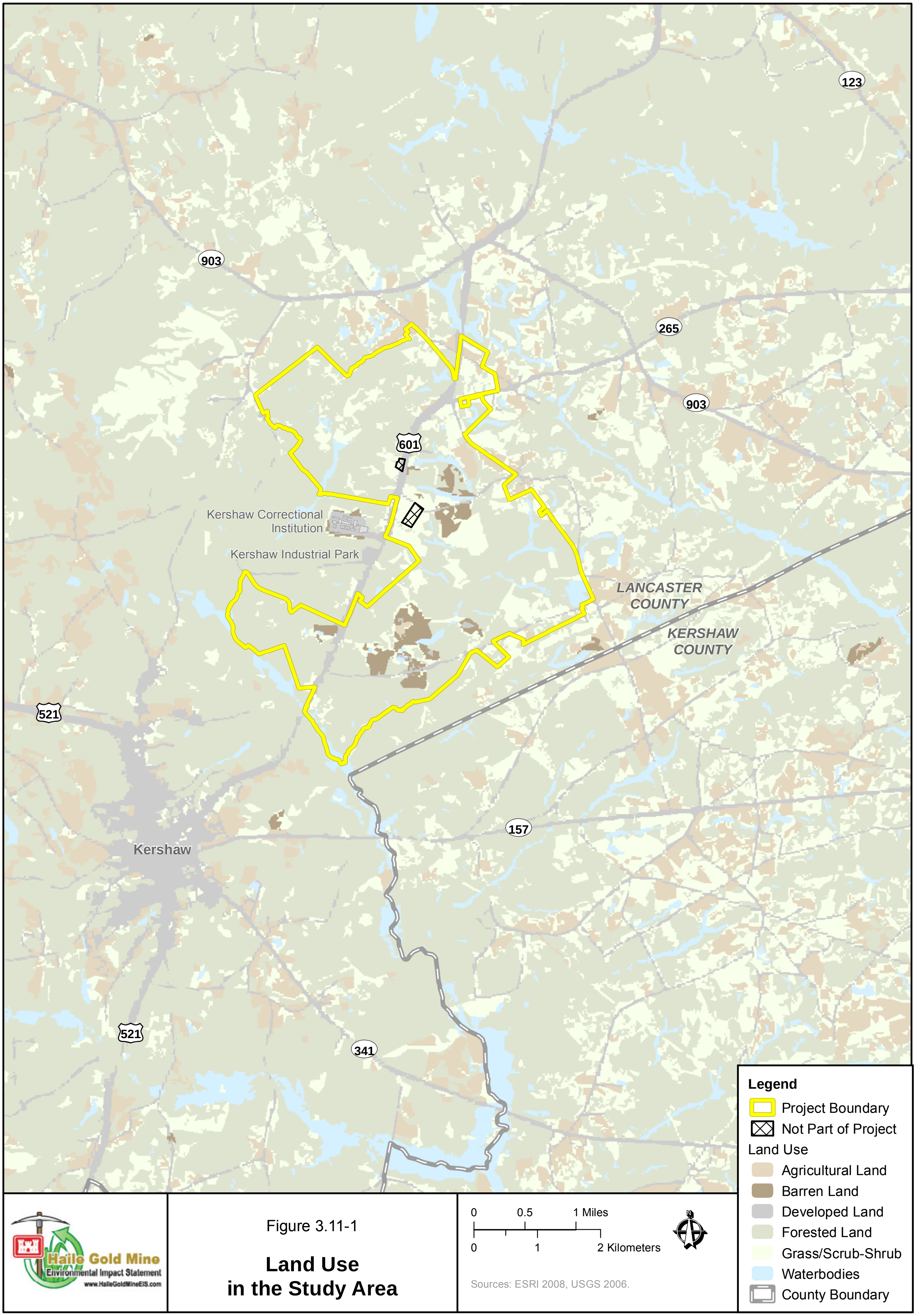


Figure 3.11-1

**Land Use in the Study Area**

- **Lancaster County Comprehensive Plan –** Lancaster County's Comprehensive Plan, *The New Millennium: A Comprehensive Plan for Lancaster County and Its Municipalities*, adopted per Ordinance 2013-1190, provides strategic planning goals and objectives for various Lancaster County resources (Lancaster County 2013a). The Comprehensive Plan addresses land use, transportation, cultural and historic resources, county demographics, housing, community facilities and infrastructure, economic development, natural resources, and transportation in the county. The Comprehensive Plan identifies existing and future land use categories within the county and within the Project area.
- **Lancaster County Unified Development Ordinance** – The Lancaster County Unified Development Ordinance (UDO) provides zoning and land use regulations for unincorporated areas of Lancaster County[1] and is promulgated by the Lancaster County Council with the recommendations of the Lancaster County Planning Board. The UDO was adopted based on the authority granted in the South Carolina Local Government Comprehensive Planning Enabling Act of 1994, which gives local planning commissions the ability to oversee local zoning[2] ordinances and implement the land use elements of the comprehensive plan. Because the SCMA does not supersede the local ordinances, mining operations must conform to Lancaster County ordinances (SCDHEC 2012).
- **Lancaster County Building Permit –** The Building Code Council of the State of South Carolina requires that all buildings comply with the 2006 International Building Code (Lancaster County 2010). A building permit is required to construct new buildings or alter existing buildings. These permits are issued by the Lancaster County Building and Zoning Department.

#### 3.11.1.3 Kershaw County Regulations

Kershaw County is located immediately south of the Project area.

- **Kershaw County Comprehensive Plan –** The Kershaw County Comprehensive Plan identifies current land uses in the northern planning area of Kershaw County as primarily agricultural, with intermittent parcels of residential, manufactured housing, and commercial and non-residential rentals. Future land uses in the northern planning area are projected to be characteristically rural; predominantly undeveloped; and primarily comprised of agriculture, forest and timber, pasture land, and mining land uses (Kershaw County 2012a).
- **Kershaw County Unified Code of Zoning and Land Development Regulations –** The Kershaw County Unified Code provides land use regulations and zoning ordinances for Kershaw County (Kershaw County 2012b). Article 3 of the Code provides zoning regulations for the unincorporated areas of Kershaw County in accordance with the Kershaw County Comprehensive Plan. Lands within the northern area of the County are zoned as Rural Resource District (RD-2), which does not allow for manufacturing development; however, mining operations are permitted within this zoning area (Kershaw County 2012b).

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1 Code of Ordinances of Lancaster, South Carolina, Codified through Ordinance No. 1153, enacted July 9, 2012. (Supp. No. 25, Update 1).

2 Zoning is a device of land use planning used by local governments to implement a county's land use plan. A zoning ordinance divides the land within a county's jurisdiction into different districts; within these districts, a zoning ordinance designates the use, location, and size of any structures placed on the property (South Carolina Association of Counties 2005).

### 3.11.2 Existing Conditions

#### 3.11.2.1 Land Use

Existing land use in the study area, based on USGS land cover maps, is predominantly forested land, open undeveloped areas of grass/scrub shrub, agricultural land, and developed land (Figure 3.11-1). Much of the area shown as forested land is occupied by rural residential land uses. The developed areas concentrated in and around the community of Kershaw include a variety of residential, commercial, and industrial land uses. Within Lancaster County, residential land use is more concentrated in the northeastern portion of the county outside of the land use study area. This portion of the county is expected to experience additional growth in the coming years (Lancaster County 2012a). Lancaster County's Economic Development Plan indicates that the southern portion of the county (including the land use study area) is more rural and is not currently experiencing significant development pressure (Insite Consulting 2009). Commercial logging also has occurred in the study area (Haile 2011).

Mining activity within the Project area has been occurring since 1827. While gold mining at the site was suspended in 1992, mining for other minerals and sand continued until 2010. Portions of the site have also been heavily logged. Post-closure reclamation monitoring programs and maintenance activities are currently in progress at the site, as required by previous mining permits. Past mining and reclamation activities within the Project area have disturbed approximately 252 acres as shown in Figure 1-3.

#### 3.11.2.2 Land Ownership

Most of the property in the vicinity of the Project area is privately owned residential, commercial, or industrial land. The nearest developed land includes the Kershaw Industrial Park; an approximately 117-acre parcel located near the mine, just west of US 601. The Lancaster County Economic Development Corporation invested public funds to make improvements at the site (including clearing and grading, access improvements, and a waterline extension) to encourage development at the site (Dennis Corporation 2013). Haile currently operates an 8,300-square-foot minerals laboratory at the Kershaw Industrial Park and has an agreement to purchase the entire Kershaw Industrial Park site (Charlotte Business Journal 2013). The Kershaw Correctional Institution, a Level 2 medium-security prison managed by the South Carolina Department of Corrections, is located just north of the Kershaw Industrial Park, also just west of US 601 (South Carolina Department of Corrections 2012).

Haile acquired the existing mine in October 2007. At that time, the total acreage of the mine property was 1,483 acres. Haile has continued to purchase additional lands since that time. As of April 2012, the Project area included 4,207 acres (Haile 2012a). In August 2012, Haile modified the Project area to include additional parcels, which increased the size of the Project area to 4,552 acres (Haile 2012b).

Forty-four of the 80 parcels within the Project boundary acquired by Haile included one or more single-family homes at the time the parcels were purchased (Haile 2013a). A total of 59 single-family homes within the Project area have been acquired by Haile. All of these homes have been or will be demolished (after proper testing for and disposal of asbestos-containing material at an approved off-site landfill, as applicable), or sold and relocated by the new owner at the owner's expense prior to the start of mining operations.

Two parcels within the Project boundary are not currently owned by Haile. Haile has approached the owners regarding purchase of these parcels. There also are currently no lease agreements in place for use of these parcels for Project purposes. Fencing and visual screening will be implemented along the property lines between the mine and these privately-owned parcels to separate these properties from Project activities (Haile 2013b). All lands acquired by Haile are owned by Haile fee simple with absolute title, including water and metal/non-metal mineral rights with no associated royalties (Haile 2012a). All fee simple property of Haile is free of all claims and access restrictions (M3 Engineering & Technology Corporation 2010). Haile owns an additional 5,310 acres of land outside of the Project boundary but within the study area.

### 3.11.2.2 Project Area Zoning

When Haile acquired the mine, mining was not designated as a permissible land use in any zoning district in Lancaster County. Mining was considered a "special use" that was allowed only under special circumstances. In 2009, Haile submitted an application to modify Lancaster County's UDO and to create a zoning designation that would encompass mining. Haile also submitted a request for rezoning of five parcels it owned. In April 2009, the Lancaster County Council approved Ordinance 979 (Lancaster County 2009a), which created UDO Section 4.1.29, *Mining and Extraction Operations*. This ordinance allows mining as a conditional use in I-2 zoning districts. Also in April 2009, the Lancaster County Council approved Ordinance 980 to rezone the five parcels (approximately 1,778 acres) located along Haile Gold Mine Road and Gold Mine Highway from R-45A, Rural Residential Intense Agricultural District to I-2 Heavy Industrial District (Lancaster County 2009b).

In 2012, Haile Gold Mine applied to re-zone an additional 87 parcels of land (approximately 3,082 acres), primarily from R-45A, Rural Residential Intense Agricultural District to I-2 Heavy Industrial District. On May, 15, 2012, the Lancaster Planning Commission unanimously approved Haile's request (Lancaster County 2012b). The request (Ordinance 1555) was approved by the Lancaster County Council on November 12, 2012, and these properties were rezoned as I-2 Heavy Industry, which allows mining operations as a conditional use (Lancaster County 2012c).

During the rezoning process, members of the community and the Lancaster Planning Commission became concerned that the I-2 Heavy Industrial zoning designation allowed a wide variety of industrial land uses, some of which were not favored by the County (e.g., landfills). The Lancaster County Planning Commission recommended development of the Mining District designation so that the residents of the county would be better served with a mining-only district that permitted only mining and related activities. Haile applied to rezone all of the Permit boundary parcels that were zoned I-2 Heavy Industrial to the new M, Mining District designation (Lancaster County 2013a). On April 8, 2013, the Lancaster County Council approved the M, Mining District as well as rezoning the Haile property within the Permit boundary to the M, Mining District designation (Ordinance 2013-1207). The allowable use under the M, Mining District is mining and related activities that involve the extraction and processing of mineral materials, including, exploration, processing, operations, and reclamation-related activities (Lancaster County 2013b).

Within the Mining District the maximum building height allowed is 70 feet (increased from the maximum height allowed of 60 feet under the I-2 zoning designation). Other applicable regulations in the Mining District per the UDO include, but are not limited to: density and dimensional regulations; parking; signs; landscaping; land development regulations; streets and sidewalks; utilities; flood, drainage, stormwater, sediment, and erosion controls; and open space (Lancaster County 2013a). Landscaping requirements per Chapter 12, Landscaping Requirements, Section 12.8 of the UDO, *Type 4 Buffer Yards*, requires:

> "*A very high density screen having a minimum width of 30 feet which is intended to substantially block visual contact between zoning classifications and create spatial separation. Type 4 buffer yard reduces lighting and noise that would otherwise intrude upon adjacent zoning classifications*" (Lancaster County 2012d).

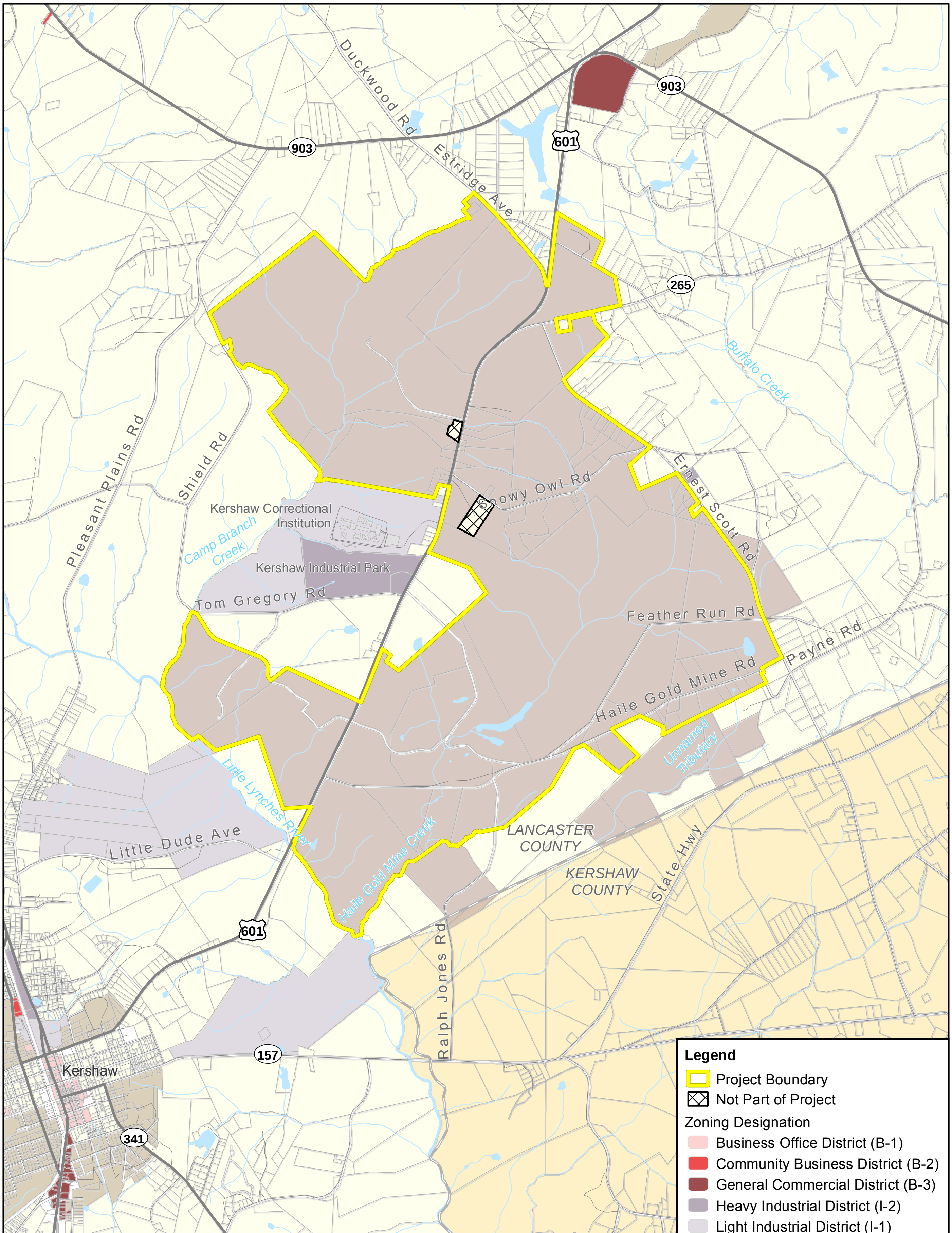
Figure 3.11-2 shows the existing zoning classifications within and adjacent to the Project area. The majority of the land adjacent to the Project area within Lancaster County is zoned as R45-A Rural Residential/Intense Agriculture Zoning District, with some areas zoned as I-1 Light Industrial District and I-2 Heavy Industrial District (Lancaster County 2012e). Adjacent lands within Kershaw County to the south of the Project area are zoned as Rural Resource District (RD-2).

### 3.11.2.3 Designated Farmland

The Farmland Protection Policy Act (FPPA) of 1994 was enacted to reduce the amount of highly productive farmland being converted to nonagricultural uses as a result of various federal programs. The FPPA is implemented under Department of Agriculture final rule effective 6 August 1984 (7 CFR 658), which requires the USACE to assess the potential impacts on farmland during the NEPA environmental review process. The analyses and results are to be included as part of the final NEPA document.

For the purposes of FPPA, designated farmlands include prime farmlands, unique farmlands, and lands of statewide or local importance. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. Farmland of statewide or local importance is land, in addition to prime and unique farmlands, that is of statewide or local importance for the production of food, feed, fiber, forage, and oil seed crops as determined by the appropriate State agency or agencies (7 CFR 657.5).

According to the NRCS, approximately 186 acres within the Project boundary is prime farmland, and an additional approximately 246 acres is farmland of statewide or local importance (Figure 3.11-3) (NRCS 2011). No unique farmland is present within the Project boundary.




Legend

Project Boundary

Not Part of Project

Zoning Designation

Business Office District (B-1)

Community Business District (B-2)

General Commercial District (B-3)

Heavy Industrial District (I-2)

Light Industrial District (I-1)

Mining District (M)

Moderate Density Residential/ Agricultural District (R-15)

Rural Residential/Intense Agriculture District (R-45A)

County Boundary

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Figure 3.11-2

**Zoning in the Study Area**

0 1,000 2,000 Feet

0 300 600 Meters

Sources: ESRI 2008, Kershaw and Lancaster Counties 2012.

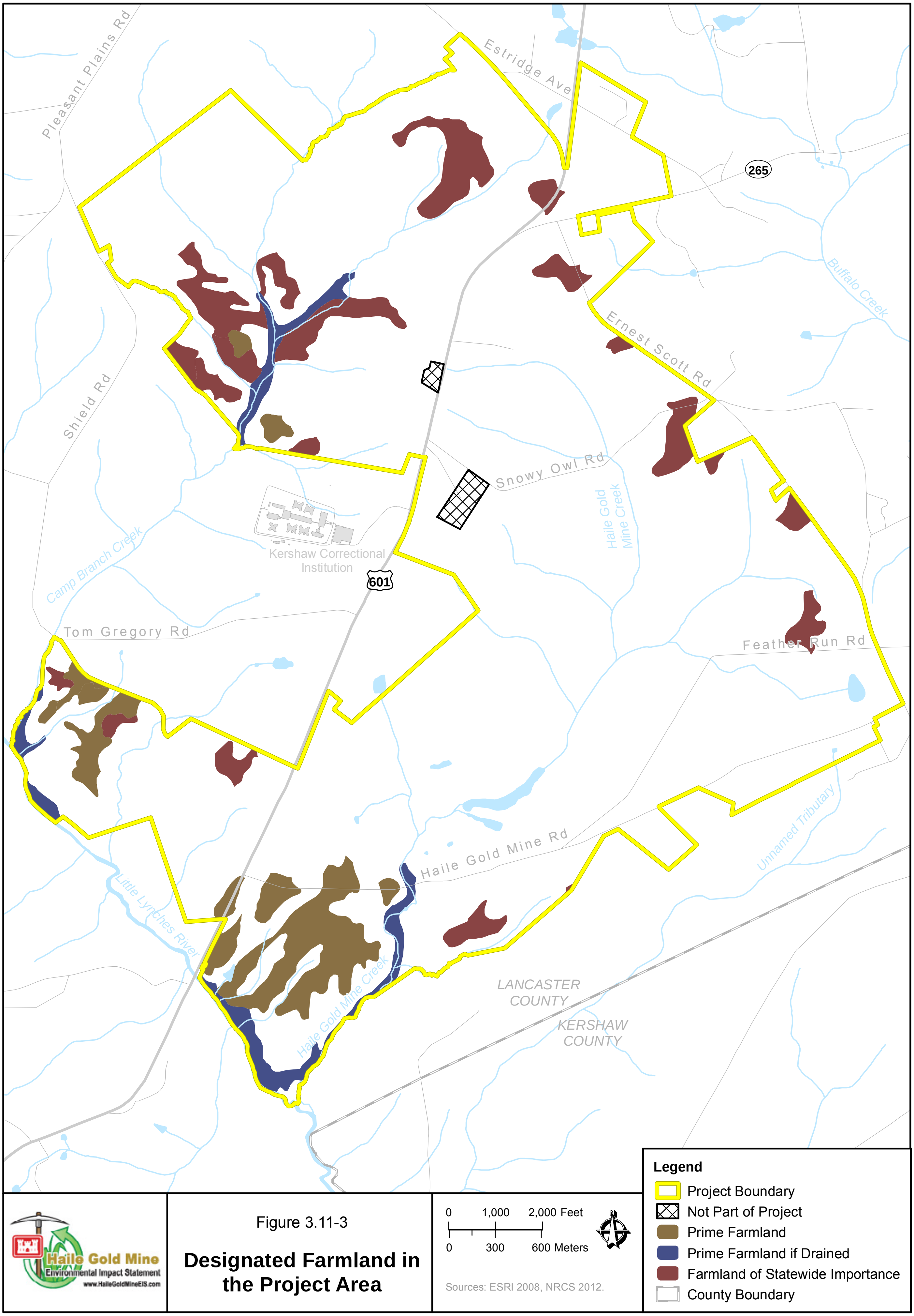


Figure 3.11-3

**Designated Farmland in the Project Area**

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# 3.12 Transportation

Implementation of the proposed Project has the potential to cause additional traffic congestion on roadways and intersections that provide access to the Project area. Construction and operation of the proposed Project may result in an increase in average vehicle delay. The addition of truck traffic may result in additional wear and tear on roadway surfaces, causing potholes or other damage. Finally, construction of new access points may increase the possibility of vehicle conflicts or collisions, especially if visibility is limited at these locations.

Because access is provided primarily by highways, the main effect of the proposed Project on transportation and circulation would involve vehicular traffic. Therefore, this analysis focuses on the street network that provides local and regional access to and from the Project area.

The SCDOT, the state agency with jurisdiction over the transportation facilities in the Project area, worked in concert with the Applicant to define the transportation study area during development of a Traffic Impact Study (TIS) for the proposed Project. Procedures and standards established by the SCDOT were used to guide the traffic analysis of existing and future conditions in the TIS (Haile 2013).

As illustrated in Figure 3.12-1, the study area for the TIS includes the following intersections that provide access to the Project area:

- US 601/Haile Gold Mine Road
- Haile Gold Mine Road/Existing Main Entrance to Haile Gold Mine
- US 601/Snowy Owl Road

These locations accommodate the highest concentration of traffic associated with the existing Haile Gold Mine and the proposed Haile Gold Mine Project.

Traffic conditions are typically described in terms of traffic counts and associated level of service (LOS) ratings. *Level of service* is a term used to characterize the performance of streets, intersections, and other highway facilities. Developed by the Transportation Research Board, and documented in various editions of the *Highway Capacity Manual* since 1950, LOS rates performance on a scale of A to F, with LOS A reflecting free-flowing conditions and LOS F representing heavily congested conditions (TRB 2010). Figure 3.12-2 illustrates the LOS ratings.

LOS for intersections is defined in terms of delay, which is a measure of driver discomfort, frustration, fuel consumption, and loss of travel time (TRB 2010). LOS criteria are stated in terms of the average delay per vehicle. This delay includes the time that motorists spend slowing down, sitting idle in a queue, moving forward in the queue, and finally accelerating through the intersection. Table 3.12-1 provides the criteria for the various LOS ratings for both one-way and two-way stop-controlled intersections, and a general description of traffic conditions associated with each LOS rating.

An indicator of highway and road safety is the traffic accident or collisions counts; usually collected by state highway departments. The South Carolina Department of Public Safety (2009) tracks and reports these statistics, using information from the *Uniform Traffic Collision Report for Investigating Officers*. These reports are submitted by members of the South Carolina Highway Patrol, city police departments, and various other law enforcement agencies.

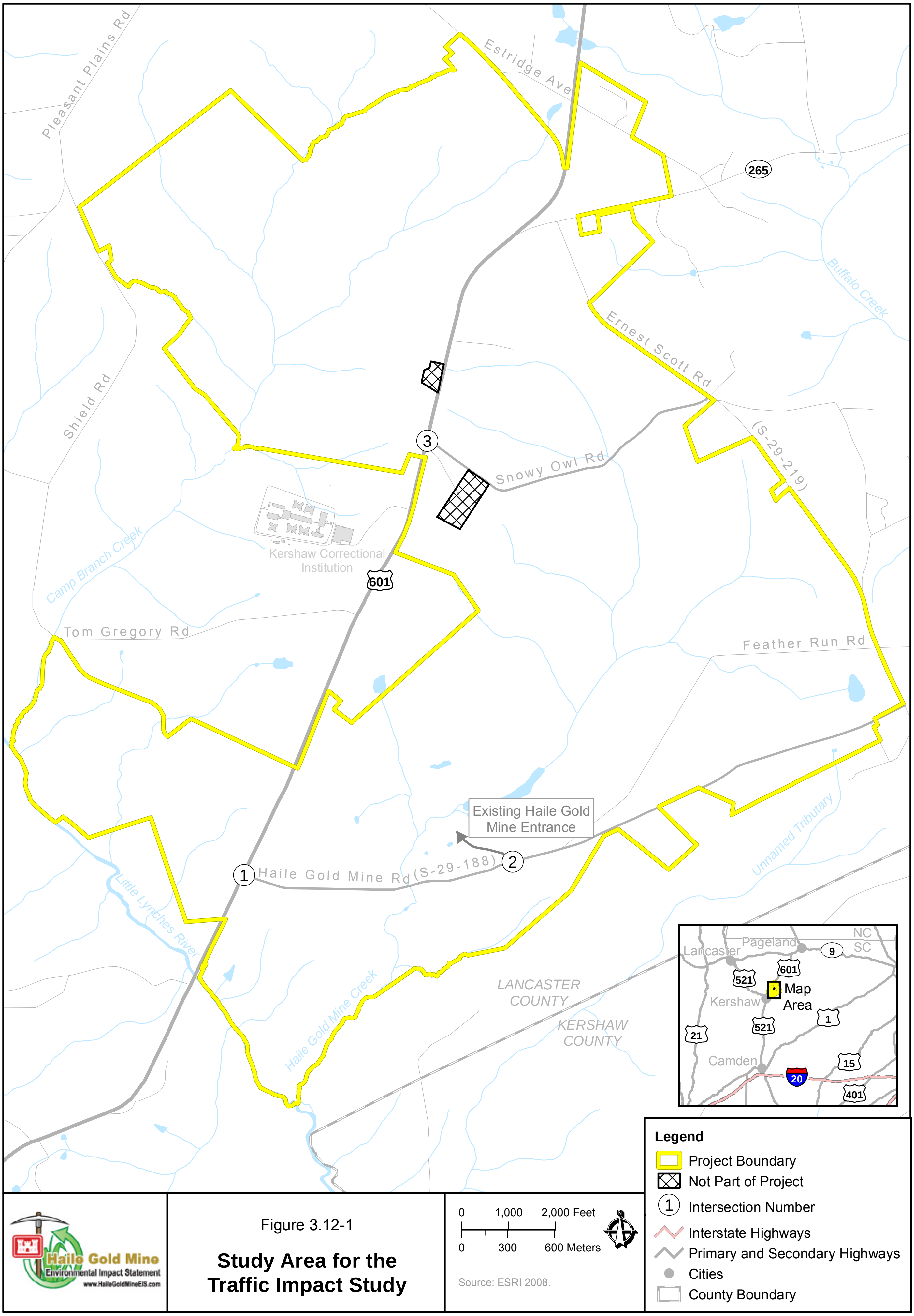


Figure 3.12-1

**Study Area for the Traffic Impact Study**

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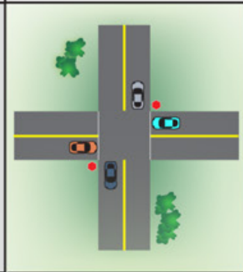
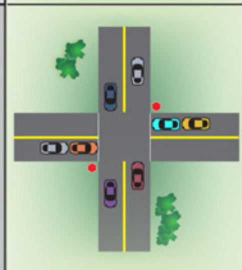
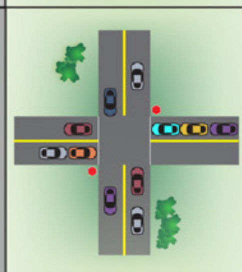
| LEVEL OF SERVICE (LOS) | | |
|---|---|---|
| LOS | Unsignalized Intersection (a) | |
| A |  | • Delay of up to 10.0 seconds per vehicle.<br>• Little or no delays to traffic on minor streets. |
| B |  | • Delay in range of 10.1 to 15.0 seconds per vehicle.<br>• Short delays to traffic on minor streets. |
| C |  | • Delay in range of 15.1 to 25.0 seconds per vehicle.<br>• Average delays to traffic on minor streets. |
| D |  | • Delay in range of 25.1 to 35.0 seconds per vehicle.<br>• Long delays to traffic on minor streets. |
| E |  | • Delay in range of 35.1 to 50.0 seconds per vehicle.<br>• Very long delays to traffic on minor streets. |
| F |  | • Delay in excess of 50.0 seconds per vehicle.<br>• Extreme delays to traffic on minor streets, with queuing. |

(a) Although a two-way stop-controlled intersection is shown, LOS delay thresholds and congestion levels are the same for all-way stop-controlled intersections.

Haile Gold Mine
Environmental Impact Statement
www.HaileGoldMineEIS.com

Figure 3.12-2

**Levels of Service**

**Table 3.12-1 Traffic Conditions Associated with Level of Service Ratings**

| LOS | Delay (seconds per vehicle) [a] | Description of Traffic Conditions |
|---|---|---|
| A | <10.0 | Traffic flows freely, with little or no restrictions to vehicle maneuvers within the traffic stream. |
| B | >10.0 and <15.0 | Reasonably free-flowing conditions, with slight restrictions to vehicle maneuvers within the traffic stream. |
| C | >15.0 and <25.0 | Traffic speed approaches free-flowing conditions, but freedom to maneuver within the traffic stream is noticeably restricted. |
| D | >25.0 and <35.0 | Traffic speed begins to be reduced, and freedom to maneuver is seriously limited due to a high concentration of traffic. |
| E | >35.0 and <50.0 | Traffic flow is unpredictable, with virtually no usable gaps in the traffic stream to accommodate vehicle maneuvers. |
| F | >50.0 | Unstable traffic flow results in delays and formation of queues in locations where traffic demand exceeds roadway capacity. |

Source: TRB 2010.

### 3.12.1 Regulatory Setting

Chapter 6 of the *Access and Roadside Management Standards* (SCDOT 2011) requires that a TIS be prepared for projects that would generate 100 or more trips during the peak hour of the traffic generator, or the peak hour of the adjacent street. As discussed in Chapter 6, the TIS is required to include an analysis of existing and future traffic conditions, and to identify appropriate transportation improvements necessary to minimize traffic impacts.

As described in Title 57, Chapter 5, Sections 10–40 of the South Carolina Code of Laws, the state highway system consists of the following categories of roads and highways:

- Interstate system of highways
- State highway primary system
- State highway secondary system

The interstate system includes facilities that were constructed following the enactment of the Federal-Aid Highway Act of 1956. Interstate 26 (I-26) and I-95 are notable examples of interstate facilities within the state. The primary system includes U.S. numbered highways (or *US highways*) and South Carolina routes, while the secondary system includes routes that are designated with a two-digit county code, followed by a three-digit route number (SCDOT 2012). US 601 and South Carolina State Road (SR) 265 are examples of the primary system, while Haile Gold Mine Road (secondary road S-29-188) is an example of the secondary system.

## 3.12.2 Existing Conditions

### 3.12.2.1 Existing Transportation Network

Analysis of a Project's effects on transportation focuses on the key characteristics of the surrounding transportation network, especially the network's capacity to accommodate the additional demand created by a proposed action. A network may include many different types of facilities that serve a variety of transportation modes, such as vehicular traffic, public transit, and non-motorized travel (such as bicycles). The proposed Project is located in Lancaster County, South Carolina, an inland area situated in the north-central portion of the state. There are no aviation, marine, or riverine facilities that provide direct access to the proposed Project or surrounding land uses (Lancaster County 2012). Access is provided by a network of highways; employee, vendor, delivery, and other trips to and from the proposed Project would be via passenger car, light truck, or heavy truck (Haile 2013).

US 601 and Haile Gold Mine Road provide local and regional access to the Project area. As discussed above, both roadways are components of the State of South Carolina state highway system (SCDOT 2012) and are administered and maintained by the SCDOT. SR 265, US 521, and Ernest Scott Road (S-29-219) are other roadways in the vicinity of the Project area that are administered and maintained by the SCDOT (SCDOT 2012).

Haile Gold Mine Road is the current main access to the existing Haile Gold Mine; Haile Gold Mine Road intersects with US 601 approximately 3 miles north of the Town of Kershaw. Within the Project area, US 601 and Haile Gold Mine Road are two-lane paved highways. Immediately adjacent land is generally undeveloped, and intersections along these roadways are relatively dispersed. Snowy Owl Road, an east/west running road located approximately 2 miles north of Haile Gold Mine Road, is a two-lane paved roadway that extends eastward into the Project area from its terminus at US 601.

Intersections in the study area are controlled by stop signs on one or more approaches (or *legs*). The US 601 intersections with Haile Gold Mine Road and Snowy Owl Road are one-way stop-controlled intersections. That is, stop signs control traffic only on the Haile Gold Mine Road and Snowy Owl Road legs. Through traffic on US 601 may pass through these intersections without stopping. The Haile Gold Mine Road intersection with the existing Haile Gold Mine entrance provides stop signs only on the northbound and southbound legs. This intersection is classified as a two-way stop-controlled intersection.

### 3.12.2.2 Existing Traffic Conditions

Existing peak morning (7:00–9:00 a.m.) and afternoon (4:00–6:00 p.m.) traffic counts were collected at all intersections in the study area on a weekday in July 2012. Existing peak through-traffic counts (not including turning traffic) are shown in Table 3.12-2. The most traffic is from the north at US 601 and Haile Gold Mine Road (a maximum of 147 vehicles from the north and 112 vehicles from the south), and the least traffic is at Haile Gold Mine Road and the existing Haile Gold Mine entrance (a maximum of 11 vehicles from the north and 15 vehicles from the south).

Table 3.12-3 displays the results of the LOS analysis under existing conditions for intersections in the study area. All existing intersections operate at LOS A conditions during both peak-hour periods.

As shown in Table 3.12-4, Lancaster County had a total of 1,446 traffic collisions in 2009, with 17 involving fatalities and 512 involving injuries. The most collisions (25 percent) occurred between the hours of 3:01 p.m. and 6:00 p.m. Collisions occurred primarily on South Carolina secondary roads (43 percent), followed by South Carolina primary roads (30 percent), and U.S. primary roads (24 percent).

### Table 3.12-2 Existing Intersection Traffic Counts in the Study Area

| Intersection | | Peak Hour | Existing Conditions | |
|---|---|---|---|---|
| | | | From North | From South |
| 1 | US 601/Haile Gold Mine Road | A.M. | 146 | 112 |
| | | P.M. | 147 | 111 |
| 2 | Haile Gold Mine Road/existing Haile Gold Mine entrance | A.M. | 11 | 15 |
| | | P.M. | 2 | 1 |
| 3 | US 601/Snowy Owl Road | A.M. | 122 | 73 |
| | | P.M. | 98 | 124 |

Source: Haile 2013.

### Table 3.12-3 Level of Service Summary for Existing Intersections in the Study Area

| Intersection | | Traffic Control | Peak Hour | Existing Conditions | |
|---|---|---|---|---|---|
| | | | | Delay [a] | LOS [b] |
| 1 | US 601/Haile Gold Mine Road | One-way stop | A.M. | 0.6 | A |
| | | | P.M. | 1.5 | A |
| 2 | Haile Gold Mine Road/existing Haile Gold Mine entrance | Two-way stop | A.M. | 6.0 | A |
| | | | P.M. | 5.7 | A |
| 3 | US 601/Snowy Owl Road | One-way stop | A.M. | 0.1 | A |
| | | | P.M. | 0.1 | A |

[a] Delay is measured in seconds per vehicle.

[b] Level of Service (LOS) calculations for existing conditions were based on the methodology in TRB (2010) and performed using Synchro 8 intersection traffic analysis software.

Source: Haile 2013.

**Table 3.12-4 Motor Vehicle Traffic Collisions, Lancaster County (2009)**

| Time Period and Type of Route | Type of Collision | | | Total Collisions |
|---|---|---|---|---|
| | Fatal | Injury | Other | |
| **Collisions by Time of Day** | | | | |
| 12:01 A.M. – 3:00 A.M. | 3 | 31 | 40 | **74** |
| 3:01 A.M. – 6:00 A.M. | 0 | 12 | 35 | **47** |
| 6:01 A.M. – 9:00 A.M. | 1 | 52 | 129 | **182** |
| 9:01 A.M. – Noon | 3 | 59 | 123 | **185** |
| 12:01 P.M. – 3:00 P.M. | 1 | 97 | 165 | **263** |
| 3:01 P.M. – 6:00 P.M. | 5 | 129 | 232 | **366** |
| 6:01 P.M. – 9:00 P.M. | 3 | 86 | 130 | **219** |
| 9:01 P.M. – Midnight | 1 | 46 | 63 | **110** |
| **Collisions by Type of Route** | | | | |
| U.S. primary | 4 | 112 | 235 | **351** |
| South Carolina primary | 4 | 157 | 272 | **433** |
| South Carolina secondary | 9 | 239 | 374 | **622** |
| Lancaster County | 0 | 4 | 36 | **40** |
| **Total collisions** | 17 | **512** | **917** | **1,446** |

Source: SCDPS 2009.

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# 3.13 Cultural Resources

Project development and operations have the potential to disturb and affect cultural resources. Cultural resources may include locations of past human activity, occupation, or use—with materials, structures, or landscapes used, built, or modified by people. Cultural resources found in or near the Project include Native American habitation and camp sites, historic farmsteads, cemeteries, mines, schools, bridges, and dams.

The USACE has defined the Cultural Resources Study Area for potential impacts on cultural resources (Figure 3.13-1) to include all historic properties[1] within the Project area per 33 CFR 325, Appendix C Part 1(g). The Cultural Resources Study Area is equivalent to the Area of Potential Effect, which is defined as the "geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist" (36 CFR 800.16 [d]).

The USACE considers the entirety of the Project area proposed by Haile to be part of the Cultural Resources Study Area. In addition, potential impacts may extend beyond the Project boundary, such as auditory, vibratory, or visual effects, so the Study Area for cultural resources was expanded to include: areas where tailings storage piles or new facilities would be visible from outside the Project boundary; areas where stream erosion or groundwater changes have the potential to affect cultural resources; areas where noise and vibration impacts may be felt; and areas where groundwater lowering may affect cultural resources (Figure 3.13-1).

Connected actions also have the potential to affect cultural resources both within and outside the Project boundary, so the proposed transmission line is included in the Study Area. In addition, the Cultural Resources Study Area includes the Sand Hill Baptist Church Cemetery, which is proposed to be expanded to accommodate the relocation of historic burials currently known to be present within the Project boundary.

## 3.13.1 Regulatory Setting

The federal and state regulations discussed in this section apply to cultural resources. See Appendix F for further details on regulations that apply to the Project.

### 3.13.1.1 Federal

As the lead agency, the USACE is responsible for documenting compliance with Section 106 of the National Historic Preservation Act (NHPA). For this Project, the USACE is following the procedures in 33 CFR Part 325, Appendix C, the USACE's *Revised Interim Guidance for Implementing Appendix C of 33 CFR Part 325 with the Revised Advisory Council on Historic Preservation Regulations at 36 CFR Part 800* dated April 25, 2005; and the USACE's January 31, 2007 *Clarification of Revised Interim Guidance for Implementing Appendix C of 33 CFR Part 325 with the Revised Advisory Council on Historic Preservation Regulations at 36 CFR Part 800 dated April 25, 2005.*

[1] A *historic property* is defined as any district, archaeological site, building, structure, or object that is listed, or eligible for listing, in the National Register of Historic Places (NRHP).

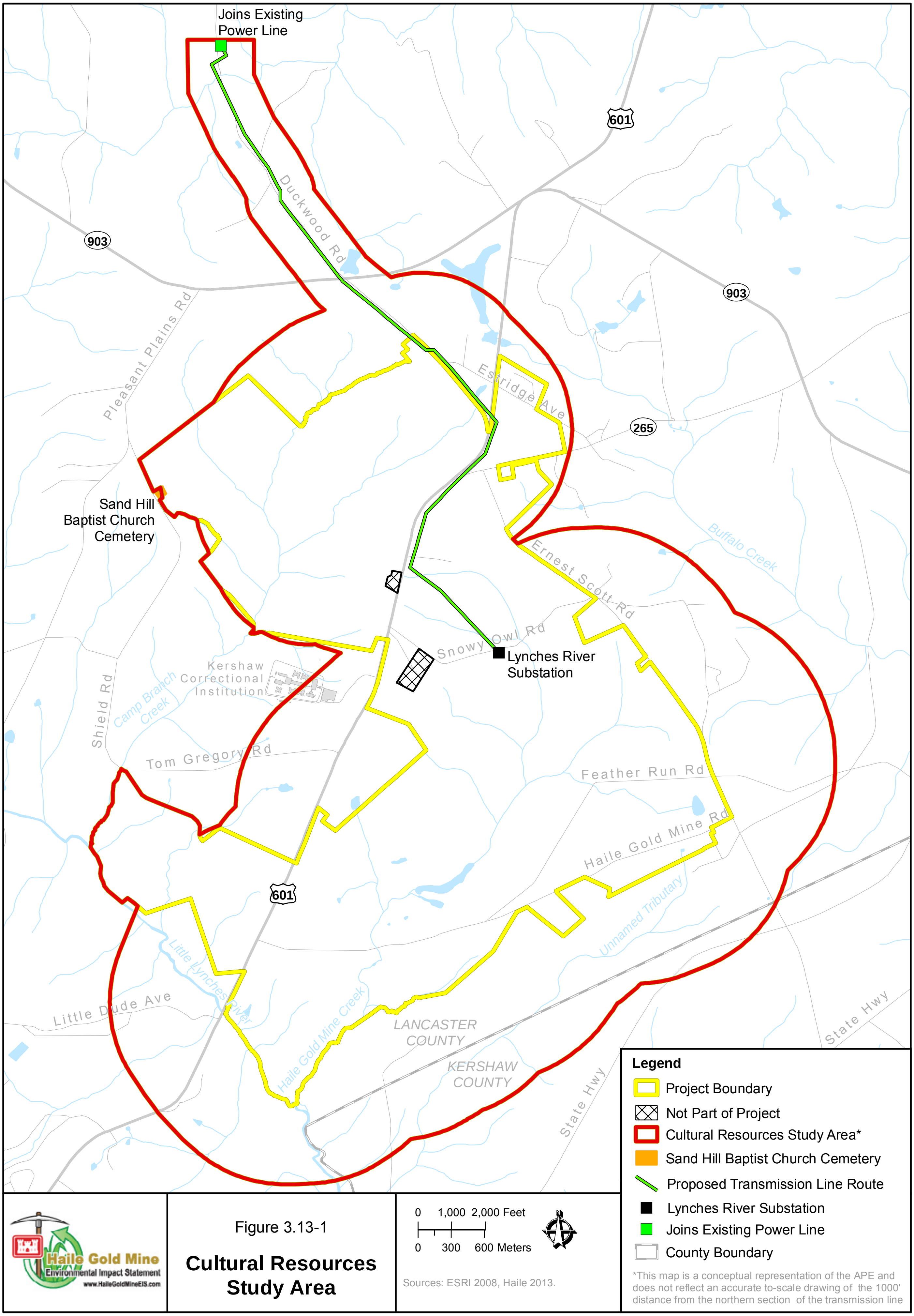



Figure 3.13-1

**Cultural Resources Study Area**

Section 106 of the NHPA requires the lead federal agency with jurisdiction over a federal undertaking to consider impacts on historic properties before that undertaking occurs. A *historic property* is defined as any district, archaeological site, building, structure, or object that is listed, or eligible for listing, in the National Register of Historic Places (NRHP). Under this definition, some cultural resources may be present within the Cultural Resources Study Area but are not considered historic properties if they do not meet the eligibility requirements for listing in the NRHP. To be designated as a historic property, the resource must be listed, or eligible for listing, in the NRHP. The criteria used to evaluate the significance of a resource are as follows:

- It is associated with events that have made a significant contribution to the broad patterns of American history; or
- It is associated with the lives of past significant persons; or
- It embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- It has yielded or may be likely to yield, information important in history or prehistory.

Properties also need to exhibit integrity of location, materials, setting, design, association, workmanship, and feeling and must be at least 50 years old, although there are provisions for listing cultural resources of more recent origin if they are of exceptional importance (NRHP 1990).

To distinguish between different types of cultural resources discussed in this section, the term *historic resource* refers to buildings, structures, objects, and districts that may or may not meet NRHP criteria of evaluation. Likewise, *archaeological resource* refers to an archaeological site that may or may not meet the NRHP criteria of evaluation. The term *Traditional Cultural Property* (TCP) refers to sites of religious and/or cultural significance or areas of concern to Indian tribes that, in consultation with the respective tribe(s), may or may not be eligible for listing in the NRHP.

The intent of Section 106 is that federal agencies take into account the impacts of a proposed undertaking on historic properties and to consult with State Historic Preservation Officers (SHPOs), federally recognized Indian tribes, applicants for federal assistance, local governments, and any other interested parties regarding potential impacts on historic properties. Under the USACE's procedures and guidelines, the District Engineer is responsible for making the final decision regarding compliance with the NHPA.

The SHPO is appointed by each state to protect the interests of its citizens with respect to issues of cultural heritage, and the NHPA provides each SHPO a prominent role in advising lead federal agencies. The lead federal agency also has an obligation to work with state and local governments, private organizations, and individuals during the Section 106 process.

On non-reservation lands, the USACE, in consultation with the SHPOs, Indian tribes (including Tribal Historic Preservation Officers [THPOs]), and other consulting parties, assesses the need for historic resource surveys and inventories and archaeological resource investigations in the Project area. The USACE also approves the methodologies for undertaking such investigations, and evaluate the NRHP status of any historical or archaeological resources located within the Cultural Resources Study Area.

#### 3.13.1.2 State

The SCMA (48-20-40, South Carolina Code of Laws) mandates that reclamation plans include "proposed methods to limit significant adverse effects on significant cultural or historic sites." Therefore, the SHPO must consult with the SCDHEC Division of Mining and Solid Waste Management concerning the potential effects of projects requiring mining permits on historic properties listed in or eligible for listing in the NRHP.

South Carolina Code 61-104 (*Hazardous Waste Management Facilities*) prohibits hazardous waste treatment, storage, and disposal facilities in areas where they will "adversely impact an archaeological site as determined by the SHPO and the State Archaeologist or a historic site as determined by the State Historic Preservation Officer."

South Carolina Code Section 16-11-780 (*Prohibition on Entering Certain Lands to Discover, Uncover, Move, Remove, or Attempt to Remove Archaeological Resource*) makes it unlawful "for a person to willfully, knowingly, or maliciously enter upon the lands of another or the posted lands of the State and disturb or excavate a prehistoric or historic site for the purpose of discovering, uncovering, moving, removing, or attempting to remove an archaeological resource."

Several South Carolina laws and regulations relate to the treatment of cemeteries and burial grounds. Section 16-17-600 (*Destruction or Desecration of Human Remains or Repositories Thereof*) of the South Carolina Code governs the removal or damage of human remains, burial grounds, or burial markers, whether historic, Native American, or modern. Title 27, Chapter 43, Article 1 outlines procedures for relocation of abandoned cemeteries as well as access to cemeteries on private property. South Carolina Code 6-1-35 provides for county or municipal preservation and protection of abandoned cemeteries.

### 3.13.2 Existing Conditions

#### 3.13.2.1 Consultation

The USACE consulted with cooperating federal and state agencies, Indian tribes, and other interested parties to locate and evaluate cultural resources in order to identify historic properties with the potential to be affected by the Project. On January 28, 2011, the USACE and the SCDHEC issued a joint public notice that requested information concerning historic properties that may be affected by the proposed undertaking from both Indian tribes and the SHPO, pursuant to Section 106 of the NHPA. On May 2, 2012, the USACE invited Indian tribes by letter to become Section 106 consulting parties. Letters from the USACE dated August 3 and 14, 2012, again invited Indian tribes that had not responded to the initial invitations. Each letter provided an overview of the Project and the invitation. Those Indian tribes that did not respond to the first or second written invitations were contacted by phone in September and October 2012. Table 3.13-1 lists the tribes notified and their responses.

#### 3.13.2.2 Historic Context

This section outlines the major historic themes that shaped the prehistory of the area as well as development of Lancaster County and the Haile Gold Mine between the 16th century and present day.

#### Prehistoric Context

Archaeologists traditionally subdivide the prehistory of the southeastern United States into a number of broad time periods, commonly understood to represent stages of development. In the Project region, the major prehistoric stages include the Paleoindian, Archaic, Woodland, and Mississippian, which may be further divided into early, middle, and late periods. Each of these stages and periods is defined by the material objects (artifacts), patterns of nutrition and settlement, and social organization of people at that time and place.

**Table 3.13-1 Tribes Invited for Consultation as Part of the Section 106 Process**

| Tribe/Nation | Response | Response Date |
|---|---|---|
| Absentee-Shawnee Tribe of Indians of Oklahoma | No response | Have not responded |
| Catawba Indian Nation | Requested status as cooperating agency and consulting party | May 10, 2012 |
| Cherokee Nation of Oklahoma | No response | Have not responded |
| Chickasaw Nation | No response | Have not responded |
| Choctaw Nation of Oklahoma | Declined consultation | June 12, 2012 |
| Eastern Band of Cherokee Indians of North Carolina | No response | Have not responded |
| Eastern Shawnee Tribe of Oklahoma | No response | Have not responded |
| Jena Band of Choctaw Indians | Declined consultation | July 25, 2012 |
| Miccosukee Tribe of Indians of Florida | No response | Have not responded |
| Muscogee (Creek) Nation | No response | Have not responded |
| Poarch Band of Creek Indians | No response | Have not responded |
| Seminole Tribe of Florida | No response | Have not responded |
| Seminole Nation of Oklahoma | No response | Have not responded |
| Shawnee Tribe | No response | Have not responded |
| Thlopthlocco Tribal Town | Requested status as consulting party | November 29, 2012 |
| Tuscarora Nation of New York | No response | Have not responded |
| United Keetoowah Band of Cherokee Indians in Oklahoma | No response | Have not responded |

The Paleoindian Stage lasted from approximately 12,000 to 8,000 before Christ (B.C.) and is marked by the first appearance of humans in what would later become South Carolina. Paleoindian populations were highly mobile hunter-gatherers who moved about the region, depending on the availability of water and the presence of stone suitable for making tools and weapons (Anderson 1996).

The Archaic Stage dates from approximately 8,000 to 1,000 B.C. and consists of three parts: Early (8,000–6,000 B.C.), Middle (6,000–3,000 B.C.), and Late (3,000–1,000 B.C.). The distinction between each period is based primarily on stylistic changes in stone tools and weapons, such as spear throwers (atlatl), and the introduction of pottery in the Late Archaic (Steponaitis 1986; Ward and Davis 1999). Climate changes during this prehistoric stage required people to find new sources of food, including new plant, animal, and aquatic species The Late Archaic dates from 1,000 B.C. to *Anno Domini* (A.D.) 900 and coincides with the establishment of modern climatic conditions. Cultural changes associated with this period across the Southeast include substantial increases in local population, increasing sedentism, and possibly the introduction of limited horticulture. As populations grew and settlements became more permanent, more complex social structures developed (Sassaman 1993).

The Woodland Stage (1,000 B.C. to A.D. 900) is marked by an increasing reliance on deliberately growing plants, living in villages with round structures, and widespread production of ceramics. More complex social organization is evident, including complex burial rituals and long-distance trade (Anderson 1985; Trinkley 1990; Wood and Bowen 1995). Studies along the middle Savannah River near Aiken, South Carolina, have suggested that most, if not all, of the region's residents left during the Early Woodland (1,000-300 B.C.) (Anderson and Joseph 1988).

The Middle Woodland (300 B.C. to A.D. 500) is marked by the introduction of check-stamped ceramics, and features elaborate cave and mound burials and increased artistic expression. Permanent settlements were located along major rivers, with smaller upland sites occupied on a permanent or seasonal basis (Sassaman 1989). Changes in stone tools suggest that the bow and arrow was introduced into the Piedmont region during the Late Woodland period (A.D. 500–900) (Wood and Bowen 1995).

Immediately prior to the arrival of Europeans within the Southeast, the Indians of South Carolina were part of what archaeologists have labeled as the Mississippian Stage. The Mississippian Stage, which began roughly A.D. 900, had large sedentary populations living in fortified villages organized as chiefdoms. Mississippian groups built platform and burial mounds, illustrating enough political complexity to organize labor for construction projects. Maize agriculture and clans were two predominant traits of the Mississippian stage (Scarry 1994). Mississippian sites were focused on major river drainages to take advantage of rich floodplain soils and riverine resources. Mississippian sites are also present in upland areas where small hamlets or hunting/foraging camps were located (Anderson 1975; Anderson and Schuldenrein 1983).

## Contact Period

The earliest European explorers and settlers within the Southeast encountered the immediate descendants of Mississippian populations. One of the earliest mentioned Indian chiefdoms in South Carolina was Cofitachequi, visited by the Spanish explorer Hernando de Soto in 1540. De Soto was told that the territory was rich with gold, silver, and pearls and was ruled over by a chieftainess, although de Soto found copper and mica in place of gold and silver. Accounts of the expedition noted large temples atop high mounds at principal towns ruled over by the "queen" of Cofitachequi (Rangel 1993 [1544]; Vega 1993 [1605]). Other Europeans known to have visited Cofitachequi include Juan Pardo in 1567 and 1568, Pedro de Torres in 1627 or 1628, and finally the Englishman Henry Woodward in 1670. Woodward, who traveled from newly settled Charles Towne to seek an alliance with the Indians of the interior, was the last to encounter the Cofitachequi within their homeland. The chief of Cofitachequi, who still held sway over a large area, visited Charles Towne later in 1670 and again in 1672 (DePratter 1994; Inabinet and Inabinet 2011).

Although the original United States de Soto Expedition Commission, formed in 1935 in preparation for the commemoration of the 400th anniversary of de Soto's journey, identified the location of Cofitachequi along the Savannah River (Swanton 1985 [1939]), recent scholars tend to prefer a placement along the Wateree River (DePratter 1994; Hudson et al. 1984). DePratter (1994), citing descriptions from the early Spanish and English accounts along with archaeological evidence—particularly the distribution of late mound sites, suggests that the Mulberry site (38KE12) only about 25 miles south of the Haile Gold Mine area near Camden is the most likely candidate for the town of Cofitachequi. It is uncertain whether the Cofitachequi ceased to exist after the 1670s, were decimated by disease, moved out of the area due to outside pressures, or were absorbed into other Native American groups (Inabinet and Inabinet 2011).

Alternatively, Waddell (2000) has argued that what ceased to exist was merely the name, not the people, and that they were in fact the Catawba who exist in South Carolina today.

The Catawba recognize their original name for themselves as *yeh is-wah h'reh*, meaning "people of the river" (Catawba Indian Nation 2008). This is commonly shortened to Iswa ("river"), which is an alternate spelling of Esaw recorded by Lawson. Lawson viewed the Esaw as a powerful nation consisting of thousands of people. The Catawba were important allies of the English, both economically and militarily. Their numbers shrank due to outbreaks of smallpox starting in the mid-1700s, so that by the 1820s, estimates of their numbers were 100 or less (Catawba Indian Nation 2008).

### Exploration and Settlement

Early European settlement of the area began in the first half of the 18th century, beginning with traders who interacted with native tribes such as the Catawba and Wateree. These tribes sided with the Yamassee, a tribe then living within the southern part of South Carolina, in a 1715–1717 war against the British traders. War and disease, including smallpox, diminished the local Catawba and Wateree populations. The Catawba tribes assimilated other diminishing tribes, including the Wateree, and after the Yamassee war aligned politically with the local white government (Inabinet and Inabinet 2011).

In 1719, South Carolina became a British colony, and interest in settling the backcountry increased. The British government encouraged Protestant Europeans to settle on lands claimed by the Wateree. The Wateree's protests were largely unsuccessful, and the tribe moved northward to a town on Catawba lands in 1739 (Inabinet and Inabinet 2011). Carolinian settlers in Kershaw were joined by a group of Quaker immigrants in the early 1750s. At that time, the local economy was based almost exclusively on agriculture. With the French and Indian War in 1755, displaced settlers—many of who were Scots-Irish, moved from the Mid-Atlantic region into the Carolinas. Continued disputes with settlers, decimation from disease, and a war with the Cherokee led the Catawba to sign the Treaty of Pine Tree Hill (Inabinet and Inabinet 2011), abandoning their ancestral land near Camden and removing to western Lancaster County (Blumer 2007).

The early 1770s saw a new wave of Scots-Irish immigrants settling in the area, building saw mills, grist mills, and pottery works that added to the local industry (Inabinet and Inabinet 2011). South Carolina became an independent state in March 1776, but the Kershaw/Lancaster County area remained relatively peaceful during the Revolutionary War until 1780, when Britain turned its attention to the southern colonies. Camden was occupied by British General Cornwallis in June 1780. A number of major and minor battles and skirmishes occurred between the two sides in this area before the British left South Carolina in December 1782 (Inabinet and Inabinet 2011). One challenge that lay before the new state was to reestablish order and a system of government, and Lancaster County was created in 1785 (Preservation Consultants 1986).

### Mining

Benjamin Haile, a Virginia landowner and planter, came to South Carolina as early as 1800, and in 1818 bought the land where the Mine is now located from Thomas Welsh (Adams et al. 2011). Gold was discovered on Haile's land in 1827, and subsequent placer mining focused on Ledbetter Creek (Adams et al. 2011). Haile mined some of the land himself and leased 50-foot squares along the creek to others. As mining progressed, the surface mines became deeper and soon were open pits reaching down 25 feet (Crowl et al. 2009). Most of the gold recovered during this period of mining was free gold found above the water table at depths of less than 60 feet. The ore dug from these pits was taken to mills up to 3 miles away to be ground (Adams et al. 2011). In 1837, Haile built a five-stamp mill for crushing ore (Adams et al. 2011), which was later increased to ten stamps (Nitze and Wilkens 1897). In the 1850s, mining stopped and the land was put up for sale.

In 1862, Anderson A.N.M. Taylor bought the mine formerly owned by Haile and mined pyrite as a source of ferrous sulfate for the Confederate government. Taylor ran the mine until 1865, when the buildings and equipment were destroyed by General Sherman's soldiers (Adams et al. 2011). After the Civil War, Phineas B. Tompkins bought a 1,805-acre tract including Haile's gold mine. By 1870, he had a six-stamp mill running, along with amalgamation and concentration equipment. His main contribution to the evolution of the mine was to start using water power (Adams et al. 2011).

In the fall of 1880, Frank W. Eldredge bought the mine at a public sale (Adams et al. 2011) and very soon afterward, sold it to the New York-based Haile Gold Mining Company (Adams et al. 2011). Haile Gold Mining Company hired E. Gybbon Spilsbury as the mine's General Manager. Spilsbury implemented the use of steam-powered drilling in underground mining, replacing Tompkins' water-powered stamp mill with a larger, steam-powered mill, and used the Designolle process of heating the ore to improve yields (Adams et al. 2011). It was also during Spilsbury's tenure that a town was built at the mine, including a post office, church, store, sawmill, railroad, and houses (Adams et al. 2011).

In 1882, Carl Adolph Thies took over operations at the mine, introducing the barrel chlorination method of extracting gold from low-quality ore (Nitze and Wilkens 1897). Until 1902, mining was primarily underground, before reverting to open pits. From 1892 to 1902, the mine was the leading gold mine in the southern United States, and Thies was widely recognized as an expert on the barrel chlorination process. By 1892, Thies had expanded the mill to 60 stamps, with water from a reservoir on Ledbetter Creek carried to the mill on wooden flumes. William Uriah Clyburn owned 20,000 acres of land locally, wood from which provided fuel for steam-powered processing equipment. Some fuel wood came from mine property as well (Adams et al. 2011). Adolph Thies retired in 1904, with his son Ernest taking over as mine manager. In 1908, an explosion destroyed the stamp mill and concentrator room, and killed two workers, including Ernest Thies. With the explosion, the mine closed abruptly and did not reopen (Adams et al. 2011).

In 1913, a cyanide plant was built to treat tailings from earlier mining (Newton et al. 1940). From 1915 to June 1917, A.K. Blakeney of Kershaw, South Carolina, worked the mine for pyrite, digging the 100-foot Blakeney shaft on Red Hill, excavating the Blakeney pits, and creating underground workings (Watkins 1918). World War I increased demand for sulphuric acid, which led to increased development of domestic pyrite reserves. During the War, mining targeted pyrite deposits while avoiding gold-rich areas to be mined after the War ended.

In June 1917, Kershaw Mining Company leased the mine to extract pyrite, with plans to build a new mill and further expand the operations (Schrader 1922). Kershaw Mining Company continued to mine the Blakeney shaft and pits, while adding the nearby Friday shaft in 1917 (Watkins 1918). Labor and capital shortages, combined with difficulties in locating and processing ores, led to a decision to stop mining in January 1919 (Schrader 1922).

In 1934, Haile Gold Mines, Inc., bought the old mining property and by 1935, had a pilot plant operating near the Beguelin Pit. In 1937, Haile Gold Mines, Inc. went into full operation with the construction of a cyanide treatment plant. In October 1938, mining began at the Red Hill Plant (Rowe and Turner 2005); and by 1940, the Haile, Bumalo, Blue Pool, Blauvelt, and Beguelin Pits were in operation—some being 150+ feet deep with vertical shafts from 50 to 350 feet deep and a maximum depth of 475 feet near the Haile Pit (Newton et al. 1940).

In 1942, War Production Board Limitation Order L208 closed nonessential gold mines in the United States, including the Haile mine, to make labor and equipment available for mining metals and minerals needed for the war effort (7 FR 7992–7993). Mining at Haile was minimal in the post-war era. According to Crowl et al. (2009), "[from] 1951 to the present, the Mineral Mining Company [Kershaw, South Carolina] has mined Mineralite® from open pits around the Haile property. This industrial product is a mixture of sericite, kaolinite, quartz, and feldspar and is used in manufacturing insulators and paint base."

Exploration during the 1960s led Cyprus Exploration Company to work the mine from 1973 to 1977. From 1985 to 1992, following 4 years of exploration, Piedmont Mining Company (Piedmont) ran open pit heap leach operations at the mine, extracting gold from oxidized deposit caps. In 1992, Amax Gold Exploration bought a majority interest in the mine, forming the Haile Mining Venture operated by Haile Mining Company to explore and evaluate future mining. Kinross Gold Corporation acquired Amax in 1998 and later became the sole owner of the Haile Mining Venture. Economic factors led to Kinross' decision to close and reclaim the mine. Romarco acquired the mine from Kinross in October 2007 and began an infill and exploration drill program (Crowl et al. 2009).

Figure 3.13-2 illustrates historic mining features in the Project area.

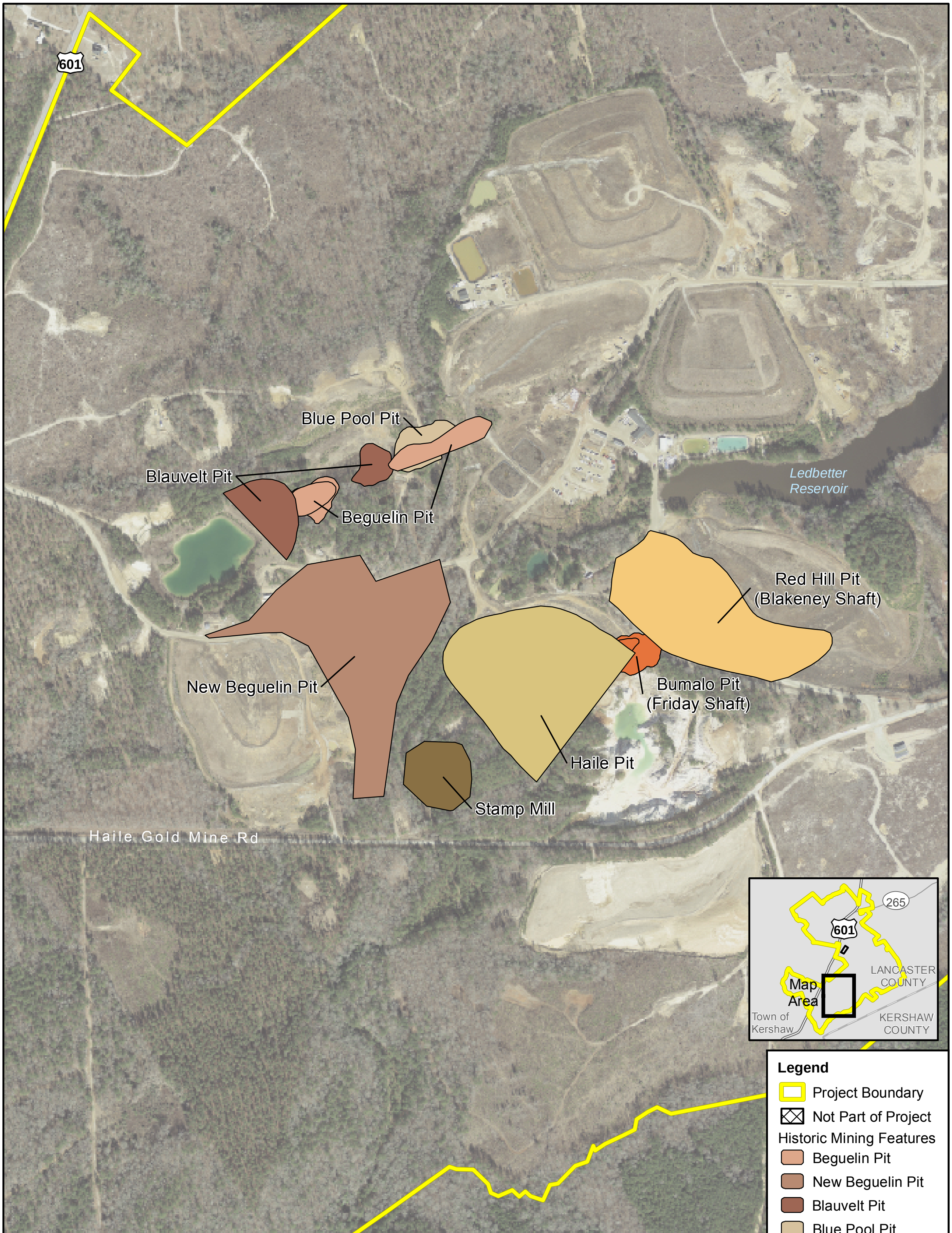
## 3.13.3 Recorded Cultural Resources

A background review of the Cultural Resources Study Area was conducted to identify previously recorded cultural resources. The research consisted of a review of the NRHP and GIS data, survey reports, and site forms at the South Carolina Department of Archives and History (SCDAH) and the South Carolina Institute of Archaeology and Anthropology (SCIAA) in Columbia, South Carolina. Additional cultural resource reports and related correspondence were provided by the Applicant. The majority of known sites have been evaluated for inclusion in the NRHP, although some resources within the Cultural Resources Study Area but outside the Project Boundary have not been assessed, and some evaluations are pending final determinations from the USACE and final concurrence on eligibility from the SHPO. Where possible, NRHP eligibility determinations for specific sites were noted. Some portions of the Project area have not been surveyed for cultural resources, and unrecorded resources could occur within the Cultural Resources Study Area.

Federal agencies are expected to make a "reasonable and good faith effort" to identify historic properties, taking into account past planning, research, and studies; the magnitude and nature of the undertaking and the degree of federal involvement; the nature and extent of potential effects on historic properties; and the likely nature and location of historic properties within the area of potential effects (36 CFR 800.4[b][1]). A total of 332 cultural resources were identified in the Cultural Resources Study Area, including archaeological sites, structures, and cemeteries.

### Archaeological Sites

Overall, 287 archaeological sites have been recorded within the Cultural Resources Study Area (see Appendix M). Of these archaeological sites, 207 are considered prehistoric, 24 as historic, and 56 with both prehistoric and historic components (multicomponent). Late Paleoindian through Late Woodland period archaeological sites are represented and a single possible Contact period site is identified. No sites within the Cultural Resources Study Area have been identified as dating to the Mississippian Stage. A total of 174 prehistoric archaeological sites have not been dated to a particular stage or period. Historic and multicomponent archaeological sites identified in the Cultural Resources Study Area date to the mid-19th through mid-20th centuries.




Haile Gold Mine Environmental Impact Statement
www.HaileGoldMineEIS.com

Figure 3.13-2

**Historic Mining Features**

0 250 500 Feet
0 75 150 Meters

Sources: ESRI 2008, Lancaster County 2011, Newton 1940, Schlumberger 2010.

### Structures

Forty-two structures have been recorded within the Cultural Resources Study Area, dating between circa (c.) 1860 and c. 1960. (See Appendix M.) These recorded structures represent a variety of resource types, including farm complexes and farm buildings, houses, outbuildings, a church, a school, a store, and a gold mine. One bridge (c. 1955) has been recorded within the Cultural Resources Study Area.

### Cemeteries

Three cemeteries are located within the Cultural Resources Study Area (see Appendix M). Leach Cemetery (reference number 38LA318) and Historic Cemetery (38LA761) are within the Project area, and the Sand Hill Baptist Church Cemetery (0961) is immediately adjacent to the Project boundary, to the northwest. Leach Cemetery and Sand Hill Baptist Church cemeteries date to the 19th and 20th centuries. Because it lacks inscribed grave markers, the date for Historic Cemetery (38LA761) is currently unknown.

Appendix M indicates the most up-to-date information available; however, because some data have not been entered into the system, site visits to the SHPO are often still required to verify accuracy. The table of historic properties is included in Section 4.13. As additional information becomes available, determinations on NRHP eligibility for the remaining resources will be conducted.

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# 3.14 Visual Resources and Aesthetics

*Visual resources* are the natural and manmade features of an area such as landforms, vegetation, water surfaces, and cultural modifications that give a particular landscape its character and aesthetic quality. The study area for visual resources is defined as the area within the Project boundary, adjacent parcels, and viewing areas from where Project-related features and construction, operations, and maintenance activities have the potential to be visible. The method for identifying key viewing areas and their locations are provided in Section 4.14.1.

Construction activities and mining operations at Haile Gold Mine have the potential to affect the visual character of the study area in the short term during construction and operations, and in the long term after reclamation. The following sections provide a discussion of the regulatory setting and existing visual character of the study area. Section 4.14 describes potential effects of the Project on visual resources and aesthetics. Appendix N provides further discussion of the methods associated with the visual resources impact assessment, in particular the identification of key viewing areas.

## 3.14.1 Regulatory Setting

The following federal, state, and local regulations are applicable to visual resources and aesthetics within the study area. See Appendix F for further details on regulations that apply to the proposed Project.

- **Section 106 of the National Historic Preservation Act –**Appendix C, Section 15.3, of *Procedures for the Protection of Historic Properties* (33 CFR 325) requires assessment of the introduction of visual, audible, or atmospheric elements that are out of character with the historic property or that alter its setting.
- **South Carolina Mining Act –** The SCMA states that the SCDNR can include requirements for visual screening (vegetative or otherwise) to shield the view of mine operations and features from public highways, parks, or residential areas if the SCDNR finds that screening is feasible and desirable. There are no lighting requirements in the SCMA (SCDHEC 1990).
- **Unified Development Ordinance –** The Lancaster County UDO provides zoning and land use regulations for unincorporated areas of Lancaster County. Because the SCMA does not supersede the local ordinances, mining operations must conform to Lancaster County ordinances (SCDHEC 2012).

Areas within the Project boundary are all designated as M, Mining District zoning (Lancaster County 2013). Within the Mining District, the maximum building height allowed is 70 feet. Other applicable regulations as required by the Lancaster County UDO include a Type 4 buffer yard and visual screening of: “A very high density screen having a minimum width of 30 feet which is intended to substantially block visual contact between zoning classifications and create spatial separation. Type 4 buffer yard reduces lighting and noise that would otherwise intrude upon adjacent zoning classifications” (Lancaster County 2012a). (See also Section 3.11, “Land Use” for more information regarding applicable land use regulations.)

Lancaster County regulates exterior lighting for mining operations under the UDO Conditional and Special Exceptional Uses Provisions (Part I, Appendix B, Chapter 4, Section 4.1.16) (Lancaster County 2012b). The UDO states that the general purpose of the lighting regulations is to prevent the pattern of light from each light source from extending onto adjacent properties. Regulations for light sources that are visible from residential or medical areas are different from those that are visible in commercial or industrial areas, as listed in Table 3.14-1.

**Table 3.14-1 Maximum Light Source Intensity Specified in the Unified Development Ordinance**

| Lighting Type | Residential/Medical Areas | Commercial/Industrial Areas |
|---|---|---|
| Bare incandescent bulbs | 15 watts | 40 watts |
| Illuminated buildings | 15 foot candles | 30 foot candles |
| Backlighted or luminous background signs | 150 foot lamberts | 250 foot lamberts |
| Outdoor illuminated signs and poster panels | 25 foot candles | 110 foot candles |
| Any other unshielded sources, intrinsic brightness | 50 candela per square centimeter | 50 candela per square centimeter |

Note:

"Foot candle," "lambert," and "candela" represent units of illumination; these technical terms indicate the intensity of light falling on a surface.

Source: Lancaster County 2012b.

### 3.14.2 Existing Visual Characteristics of the Project Area

An inventory of visual resources generally includes the components of landscape character, scenic integrity, viewer sensitivity, and viewing distance. The following summarizes the key elements considered for each of these components (Smarden et al. 1988; USFS 1995; BLM 2012a, 2012b):

- **Landscape Character –** The existing landscape character is described by identifying characteristic landscape units or areas that contain similar landforms, vegetation, landscape features (water, exposed rock) and degree of cultural modification or development. Within the Project boundary, these features include both existing natural features and results of previous mining activities.
- **Scenic Integrity –** The scenic integrity of an area is characterized by the degree to which the landscape character is coherent or appears to be unaltered and natural in appearance. High scenic integrity would include areas where human activities are not readily apparent when viewing the landscape, and lower scenic integrity would be areas where the landscape has been obviously altered by humans.
- **Viewer Sensitivity –** Viewer sensitivity is determined by the number of viewers, the duration of the views, the context of the viewing setting, viewing distances, and viewer expectations. For example, designated scenic overlooks associated with recreation areas would have higher viewer sensitivity due to the number of potential viewers and the expectations of the viewers for a scenic view.
- **Viewing Distance –** Views can be characterized by viewing distances, or distance zones in relation to the viewing location, such as foreground (views from approximately 0 to approximately 0.5 mile), middle ground (views from approximately 0.5 to approximately 3 miles), background (views from approximately 3 to approximately 5 miles), and seldom seen views (views typically greater than 15 miles). Details in the foreground and middle ground views are more visible, and they are less visible in the background or seldom seen views. Therefore, viewers would be more sensitive to landscape changes to foreground and middle ground views.

The existing visual resources include natural features such as landforms, vegetation, and water, and cultural modifications or physical changes to the area attributable to human activities. The visual character of the study area is primarily rural; agricultural and forested lands are interspersed with low-density residential areas. The topography within and adjacent to the Project site includes areas of predominantly rolling terrain with moderate elevation changes and other areas with steeper hills and valleys. Within the Project area, existing elevations range from approximately 330 to 640 feet; some of these topographic features are a result of previous mining activities.

#### 3.14.1.1 Landscape Character and Scenic Integrity

Within the study area, the landscape character units are comprised of generally five types of landscape units, including forested landscape, open shrub/scrub area, residential, commercial/industrial, and mining. Approximately 252 acres within the Project boundary are mining areas where lands have previously been disturbed and/or reclaimed. Open/scrub shrub areas and forested areas also are present. A few residential areas and a commercial/industrial area are adjacent to the Project boundary. Other areas in the general vicinity of the Project are predominantly open/scrub shrub and forested. Brief descriptions of the identified landscape character units and representative photos are provided below.

##### Forested Landscape Unit

The forested landscape unit includes primarily forested areas with a combination of deciduous and coniferous trees and undergrowth vegetation. The vegetation generally ranges up to 40–60 feet in height, with areas of dense vegetation. Figure 3.14-1 is representative of a forested landscape unit.

Figure 3.14-1 Forested Landscape Unit

##### Open Scrub-Shrub Area Landscape Unit

The open scrub-shrub landscape unit includes grasslands areas with interspersed lower scrub-shrub vegetation and occasional taller trees. The areas are typically characterized by relatively flat topography, with occasional exposed soil areas. Figure 3.14-2 is representative of an open scrub-shrub landscape unit.

Figure 3.14-2 Open Scrub-Shrub Area Landscape Unit

### Residential Areas Landscape Unit

The residential areas landscape unit includes rural residences with some residential structures and generally open areas. Figure 3.14-3 is representative of a residential areas landscape unit.

Figure 3.14-3 Residential Areas Landscape Unit

### Commercial/Industrial Landscape Unit

The commercial/industrial landscape unit includes commercial/industrial areas, such as the Kershaw Industrial Park, the Kershaw Correctional Institution and associated facilities, and the existing mine facilities. Figure 3.14-4 is representative of a commercial/industrial landscape unit.

Figure 3.14-4 Commercial/Industrial Landscape Unit

### Mining Area Landscape Unit

The mining area landscape unit includes areas that have been previously disturbed; reclaimed overburden areas and past vegetative clearing are evident. The areas can be relatively steep and include exposed rock and/or soils. Figure 3.14-5 is representative of a mining area landscape unit.

### 3.14.1.2 Viewing Distances and Viewer Sensitivity

Views within and adjacent to the Project area are predominantly foreground and middle ground views close to the viewer, with occasional background views of the region. Views from areas adjacent to the Project primarily consist of views from roadways, residential areas, and the Kershaw Industrial Park on US 601. Views to the Project area are typically from roadways; potential viewers are driving, with short-duration views of the Project area.

The existing mine facilities are located in a lower valley area and thus not readily visible from roadways or public viewing areas because of the topography and vegetation within the Project boundary. The existing mine facilities include some lighting features that would be visible from adjacent land areas, but lighting is not prominently visible from roadways because the proposed facilities would be located away from public roadways and screened by forested and vegetated areas.

Views at intersections and at the parking lot of the Kershaw Industrial Park afford slightly longer viewing durations, but views would still be relatively short in duration. Views from adjacent residences provide opportunities for views of longer duration compared to other possible viewing locations. Because of previous mining activity, residential development, and commercial/industrial development, many of the views within the vicinity of the Project include some degree of cultural modification or development.

Figure 3.14-5 Mining Area Landscape Unit

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# 3.15 Recreation Resources

For the purposes of this EIS, *recreation resources* are generally defined as publicly accessible facilities and land areas that provide recreational opportunities for wildlife viewing, hunting, fishing, picnicking, and hiking activities. The study area for recreation resources includes the Project area and public recreation areas within approximately 15 miles of the Project boundary (Figure 3.15-1). Potential issues that could affect the recreational experience would include changes to the recreational setting and experience caused by Project-related noise or visual changes, impaired access to recreational areas, degraded recreational fishing and hunting opportunities, and conflicts with adopted recreation plans or policies. Section 4.15 describes the potential effects of the proposed Project on recreation resources within the study area.

## 3.15.1 Regulatory Setting

The Project is located entirely on private land owned or controlled by Haile Gold Mine; no federal lands are within the Project boundary (M3 Engineering & Technology Corporation 2010). In addition, no federal lands are located adjacent to the Project; therefore, no applicable federal recreational management plans are associated with the Project area (National Atlas 2012). Appendix F contains further details on regulations that apply to the Project.

The following state plans and programs apply to recreation in the study area.

- ***State Comprehensive Outdoor Recreation Plan –*** The South Carolina Department of Parks, Recreation and Tourism (SCDPRT) is the primary agency responsible for outdoor recreation planning in the state, including both promoting tourism and coordinating recreational opportunities (SCDPRT 2008). South Carolina's 2008 *State Comprehensive Outdoor Recreation Plan* (SCORP) guides federal, state, and local governmental agencies and entities involved in recreation planning and development. The SCORP highlights recreation resources, analyzes demand for recreational opportunities, and identifies statewide recreation planning goals and objectives. The SCORP states that demand for recreational opportunities continues to grow as the State's population grows and identifies outdoor recreation as an integral, yet largely untapped, role in South Carolina's tourist industry—especially for the rural, inland communities.
- ***South Carolina State Trails Plan –*** The *South Carolina State Trails Plan* presents a comprehensive plan for trail development in the state. Its purpose is to create a better trail experience, to establish priorities, and to be used as a marketing tool for the recreation industry (SCDPRT 2002). The Plan provides an inventory of existing and proposed trails, including Lancaster County's 10 miles of existing hiking and biking trails. Approximately 4.5 miles of those trails are located in Forty Acre Rock Heritage Preserve. Approximately 2 miles of trails are located in Andrew Jackson State Park, which is approximately 20 miles northwest of the Project. Short segments of hiking and biking trails (less than 1 mile each) are found in the Kershaw, Flat Creek, Indian Hill, and Heath Springs recreational areas (Figure 3.15-1).

The following local plans address recreation resources in the study area:

- ***The Carolina Thread Trail Master Plan –*** In October 2011, the Lancaster County Board of Commissioners adopted *The Carolina Thread Trail Master Plan* to guide development of the South Carolina Thread Trail in Lancaster County (Carolina Thread Trail 2011). The Thread Trail is a 15-county, two-state initiative to create a regional network of trails, blueways, and conservation corridors. Local communities plan and implement their portions of the trail system (Bray 2011). The Kershaw Greenway is a 15-mile priority trail segment proposed in the Master Plan that extends north from the Town of Kershaw through the Forty Acre Heritage Preserve. This proposed segment would pass through a portion of the Project to the west of US 601 and along US 601 just north of the mining area (see Figure 3.15-1).The Master Plan states that a potential challenge with the development of this trail segment is that it would pass through a portion of an active mining area. While the Master Plan identifies potential locations for trail segments, it outlines actions for Lancaster County to further develop and implement the trail segments, such as evaluating land acquisition options, assessing zoning, obtaining funding, and developing final trail location and design.

- **Lancaster County *Comprehensive Plan* –** This plan is described in Section 3.11, "Land Use." For recreation resources, the *Comprehensive Plan* (Lancaster County 2013) promotes development of recreational facilities in rural areas and community centers in the municipalities of the Lancaster, Heath Springs, Kershaw, and Indian Land areas. It also promotes development of family-oriented recreational facilities, such as bowling alleys, skating rinks, and community swimming pools.

### 3.15.2 Existing Conditions

There is no existing public recreation access to the Project area, and no public recreation areas are located on parcels adjacent to the Project. The area is dominated by scrub and forestland that was previously disturbed by mining activities and that has been reclaimed and revegetated. Lease hunting has historically occurred in the area, but since Haile has purchased and consolidated its landholdings, lease hunting has been largely phased out. At present, only one small area remains within the project boundary on which limited hunting by a previous landowner occurs. Public recreation areas within the study area include the Forty Acre Rock Heritage Preserve and Wildlife Management Area, the Carolina Sandhills National Wildlife Refuge (NWR), the Sandhills State Forest, and several Lancaster County-managed parks (see Figure 3.15-1).

The Forty Acre Rock Heritage Preserve and Wildlife Management Area, located approximately 1 mile north of the northern tip of the Project area, is managed by SCDNR and is designated as a National Natural Landmark (SCDNR 2007). The 2,267-acre Forty Acre Rock Heritage Preserve is popular for hiking and nature viewing. Hunting is permitted on parts of the preserve. The preserve provides protection for nearly a dozen rare, threatened, or endangered plant and wildlife species, and is known as one of the best birding and wildflower locations in South Carolina. The preserve has a maintained trail system that includes foot bridges and boardwalks (WildlifeSouth 2012).

The 45,348-acre Carolina Sandhills NWR is located approximately 10 miles east of the Project in Chesterfield County, South Carolina. The primary purpose of the NWR is conservation of natural resources and habitats, and preservation of endangered and threatened species. The NWR is primarily forested woodlands, with some fields and open spaces, and receives 50,000 to 60,000 visitors annually. Primary recreational opportunities include an auto tour route, hiking, wildlife observation, fishing, and hunting (USFWS 2010). The *Carolina Sandhills National Wildlife Refuge Comprehensive Management Plan* outlines management programs, objectives, and corresponding resource needs for a 15-year period—with the goal of optimizing refuge operations by balancing enhanced habitat and fish and wildlife population management, and wildlife-dependent public uses (USFWS 2010).

The Sandhills State Forest, comprised of a 46,838-acre tract in Chesterfield and Darlington Counties, is located directly southeast of the NWR and is managed by SCDNR. Sugar Loaf Mountain Recreation Area, located within Sandhills State Forest, is one of the most popular equestrian recreation areas in the region. This area provides hunting, hiking, horseback riding, biking, boating, fishing, picnicking, and camping opportunities (SCDNR 2012b).

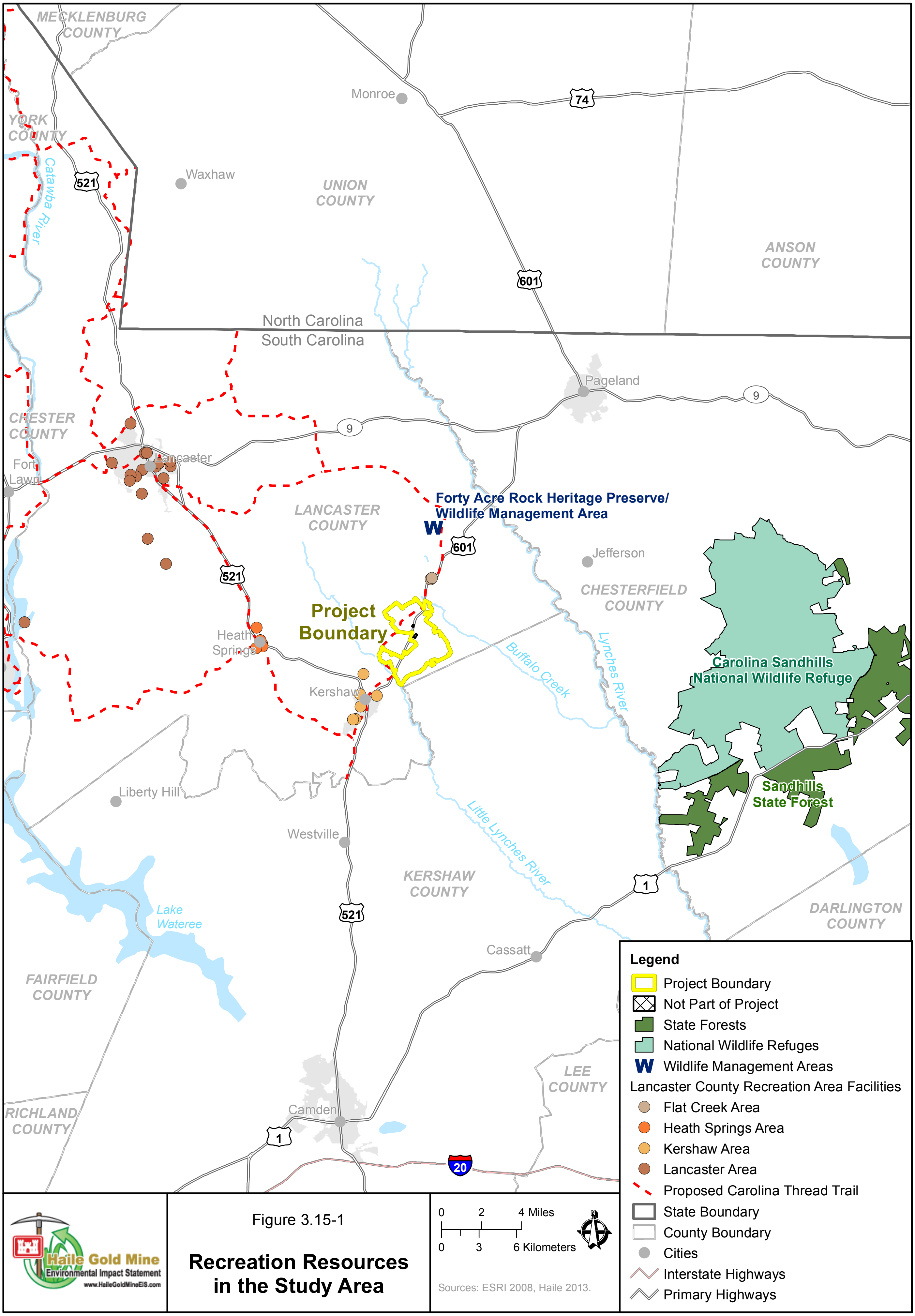


Figure 3.15-1

**Recreation Resources in the Study Area**

Sources: ESRI 2008, Haile 2013.

5 miles west of the Project (Lancaster County 2010). In addition, there are 17 county-managed parks in the Lancaster area located approximately 15 miles northwest of the Project area. These parks range in size from less than 1 acre to the 65-acre Springdale Recreation Complex in Lancaster. These recreation areas provide a variety of recreation facilities and opportunities, including multi-use fields, picnic areas, hiking trails, playground facilities, boat launch areas, and playground facilities.

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# 3.16 Air Quality

The proposed Project could affect the ambient air quality conditions in the Project area by generating direct emissions of criteria pollutants, fugitive PM emissions, hazardous air pollutants (HAPs or toxic air pollutants), and greenhouse gases (GHGs)[1] through the use of on-road vehicles, off-road equipment, and stationary equipment for exploration, development, construction, operations, maintenance, and reclamation of the mine. These emissions could affect sensitive receptors. Sensitive receptors are land uses that can be more sensitive to air quality based on the population groups present or activities involved. Potential emissions from increased local traffic could result from Project-related activities. In addition, Project-related emissions could contribute to climate change. Section 4.16 addresses potential air quality impacts caused by the proposed Project.

The study area for potential air quality impacts is the Metropolitan Charlotte Interstate Air Quality Control Region (AQCR). As defined in the CAA (42 USC 7407), an *AQCR* is a contiguous area considered to have relatively uniform ambient air quality. An AQCR is treated as a single unit for reducing emissions and determining compliance with the National Ambient Air Quality Standards (NAAQS). The Metropolitan Charlotte Interstate AQCR consists of Cabarrus, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, and Union Counties in North Carolina; and Chester, Lancaster, Union, and York Counties in South Carolina. Figure 3.16-1 illustrates the boundaries of the AQCR. The proposed Project is located near the southeastern boundary of the Metropolitan Charlotte Interstate AQCR. Any pollution from adjacent AQCRs would be accounted for under the South Carolina Cross-State Air Pollution Rule (CSAPR), as discussed in Section 3.16.1.2.

## 3.16.1 Regulatory Setting

### 3.16.1.1 Air Quality Standards

Ambient air quality is regulated by federal, state, and local agencies. The USEPA has established NAAQS for six criteria pollutants: particulate matter ($PM_{10}$ particulates [air pollutants with a diameter of greater than 2.5 micrometers (μm) and less than approximately 10 μm] and $PM_{2.5}$ particulates [air pollutants with a diameter of 2.5 μm or less]), sulfur dioxide ($SO_2$), carbon monoxide (CO), nitrogen dioxide ($NO_2$), ozone ($O_3$), and lead (Pb) (USEPA 2012a; SCDHEC 2012a). The NAAQS include primary standards to provide public health protection, including protecting the health of “sensitive” populations, such as asthmatics, children, and the elderly; and secondary standards to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Over time, several secondary standards have been superseded by primary standards for stringency. The federal CAA requires the USEPA to set outdoor air quality standards for the nation and allows states to adopt additional or more stringent air quality standards as needed. Under the CAA, states cannot adopt standards less stringent than the federal standards.

[1] *Greenhouse gases* are gases that absorb and emit radiation within the thermal infrared range.

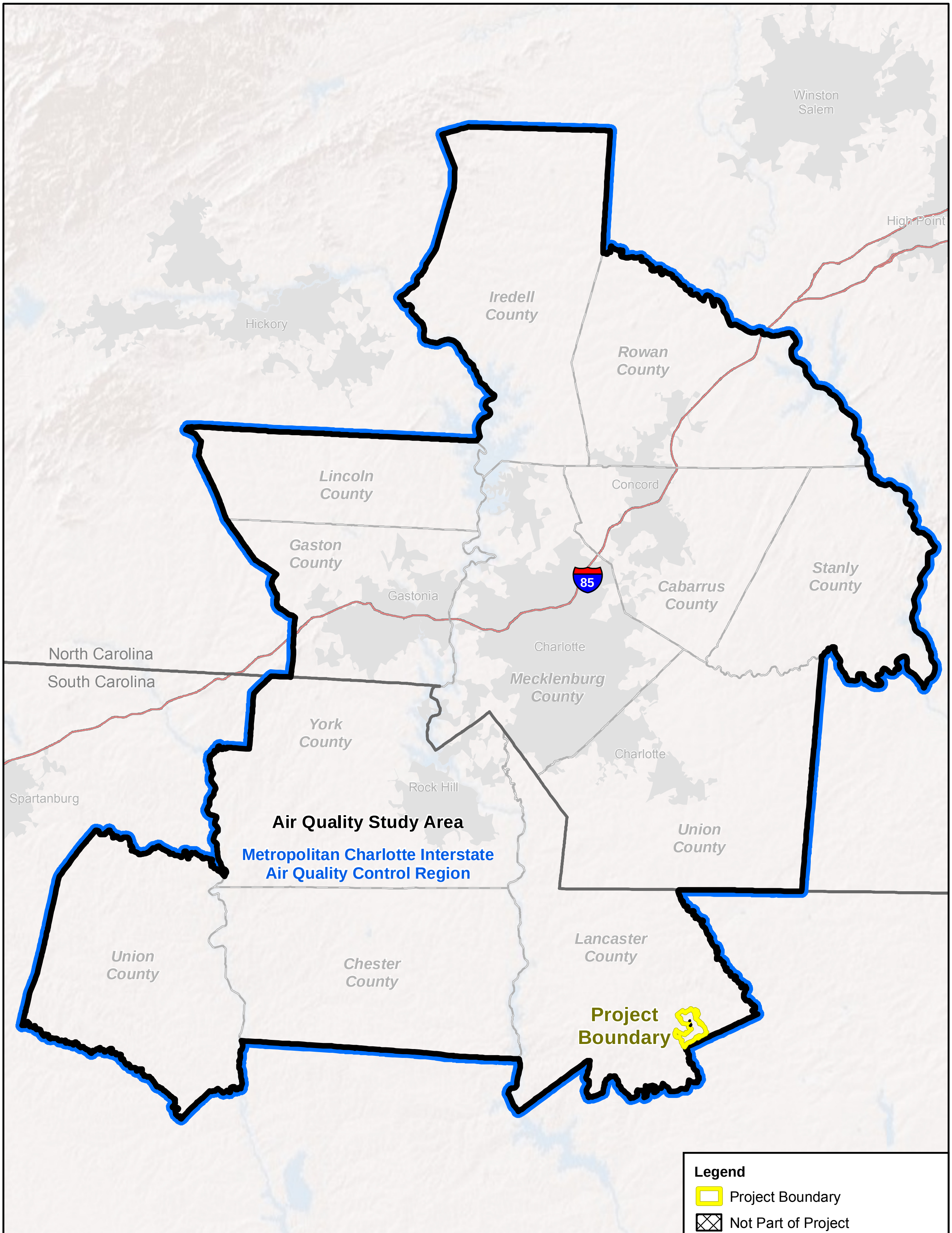


Figure 3.16-1

**Air Quality Study Area**

Areas that violate (or did not attain) federal or state air quality standards are designated as *nonattainment* areas for the applicable pollutants. This contrasts with areas that comply with federal and state air quality standards, which are designated as *attainment* areas (areas that have attained compliance) for the applicable pollutants. Areas with insufficient data are designated as *unclassified* or *attainment/unclassified* areas and are treated as attainment areas under the CAA. Areas previously designated as nonattainment that have demonstrated compliance with an NAAQS are designated as *maintenance* for 20 years after the effective date of attainment, assuming that the area remains in compliance with the standard.

Federal funding actions or other approvals in nonattainment and maintenance areas are subject to Transportation Conformity Rule requirements, which apply to certain types of transportation projects, or General Conformity Rule requirements, which can apply to other types of federal actions. A General Conformity Determination is required for federally sponsored or funded actions in NAAQS nonattainment areas, or in certain maintenance areas, when the total direct and indirect net emissions of nonattainment pollutants (or their precursors) exceed specified thresholds (Section 176[c] of the CAA Amendments of 1990). This regulation ensures that federal actions conform to the SIP and agency NAAQS attainment plans.

South Carolina has established a SIP, which describes how the state will comply with the CAA and achieve attainment with federal and state air quality standards. The SIP consists of narrative, rules, technical documentation, and agreements the State uses to maintain acceptable air quality and to improve air quality in areas with unacceptable levels of atmospheric contaminants.

The SCDHEC has adopted ambient air quality standards that are the same as the NAAQS; however, they have not formally adopted the 1-hr $SO_2$, 1-hr $NO_2$ and the $PM_{2.5}$ annual standard into the SIP. South Carolina is complying with these standards and facilities triggering $SO_2$, $NO_2$ and/or $PM_{2.5}$ for Prevention of Significant Deterioration permits must comply with federal permitting requirements. South Carolina also has a HAP standard for gaseous fluorides (as hydrogen fluoride [HF]). Table 3.16-1 lists the NAAQS and South Carolina standards for the six criteria pollutants and gaseous fluorides. The table shows the averaging time for each standard, which is the time period over which air pollutant concentrations are averaged for the purpose of determining attainment with the NAAQS.

### 3.16.1.2 Regulations for Direct Emissions

Federal and state regulations and standards that govern Project-related direct emissions of criteria pollutants, HAPs, and GHGs are listed below. See Appendix F for further details on regulations that apply to the Project.

- **SCDHEC, Bureau of Air Quality Air Pollution Control Regulations and Standards –** The Bureau of Air Quality develops and implements regulations and State Implementation Plan (SIP) revisions based primarily on federal mandates. Many regulations enacted under the federal CAA are adopted by reference, while other state regulations are broader than the federal requirements or are developed because of a more local air quality issue.
- **CAA Title V Operating Permits –** A Title V major source is a source or group of stationary sources (including new and existing sources) within a contiguous area and under common control that emit or have the potential to emit criteria pollutants or HAPs above the criteria pollutant threshold values (100 tons per year [tpy] for criteria pollutants; 25 tpy for all HAPs or 10 tpy for any one HAP).

**Table 3.16-1 National and South Carolina Ambient Air Quality Standards**

| Pollutant | Standard Type | Averaging Time | Concentration | | Statistical Form |
|---|---|---|---|---|---|
| | | | ppmv | µg/m³ | |
| Ozone ($O_3$) | Primary and secondary | 8-hour | 0.075 | 147 | Annual 4th-highest daily maximum 8-hour concentration averaged over 3 years |
| Nitrogen dioxide ($NO_2$) | Primary | 1-hour* | 0.100 | 188 | 98th percentile averaged over 3 years |
| | Primary and secondary | Annual | 0.053 | 100 | Annual mean |
| Sulfur dioxide ($SO_2$) | Primary | 1-hour* | 0.075 | 196 | 99th percentile of 1-hour daily maximum concentrations averaged over 3 years |
| | Secondary | 3-hour | 0.5 | 1,309 | Not to be exceeded more than once per year |
| Carbon monoxide (CO) | Primary | 1-hour | 35 | 40,072 | Not to be exceeded more than once per year |
| | | 8-hour | 9 | 10,304 | |
| Particulates (as $PM_{10}$) | Primary and secondary | 24-hour | — | 150 | Not to be exceeded more than once per year on average over 3 years |
| Particulates (as $PM_{2.5}$) | Primary and secondary | 24-hour | — | 35 | 98th percentile averaged over 3 years |
| | | Annual* | — | 15 | Annual mean averaged over 3 years |
| Lead (Pb) | Primary and secondary | 3-month rolling | — | 0.15 | Not to be exceeded at any time |
| Gaseous fluorides (HF) | State regulation (1978) | 12-hour | — | 3.7 | Not to be exceeded at any time |
| | | 24-hour | — | 2.9 | |
| | | 1-week | — | 1.6 | |
| | | 1-month | — | 0.8 | |

Notes:

*National standards not yet adopted by the State of South Carolina

ppmv = parts per million by volume

µg/m³ = micrograms per cubic meter

For gases, the equivalent µg/m³ is calculated from ppmv based on molecular weight and standard conditions:

- Standard ambient temperature 25°C
- Standard barometric pressure 760 mm Hg (millimeters/mercury)
- Standard molar volume 24.465 liters/g-mole

Sources: USEPA 2012a; SCDHEC 2012a.

- **CAA New Source Performance Standards (NSPS) –** The NSPS regulate emission rates and provide requirements for new or significantly modified sources. NSPS requirements include emission limits, monitoring, reporting, and record keeping.

- **CAA National Emission Standards for Hazardous Air Pollutants (NESHAPs)/Maximum Achievable Control Technology (MACT) –** The NESHAPs regulate emissions of HAPs from new and existing sources—specifically eight hazardous substances: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The 1990 CAA

Amendments established a list of 189 HAPs, resulting in the promulgation of Part 63, also known as the MACT standards. These standards regulate HAPs from major sources of HAPs and HAPs from specific source categories that emit HAPs. The facility is also subject to the Gold Mine MACT as an area source under Section 112(k) of the CAA, which requires reduction in air toxics from area sources in urban areas; identification of source categories emitting HAPs; and development of standards for identified source categories.

- **USEPA Mobile Source Regulations –** Gasoline and diesel engines must comply with the USEPA mobile source regulations for on-road and non-road engines to minimize emissions. The requirements are imposed on the manufacturers of the engines.
- **USEPA Compliance Assurance Monitoring (CAM) –** The USEPA developed CAM to provide reasonable assurance that facilities comply with emissions limitations, by monitoring the operation and maintenance of their control devices. CAM requirements apply to emission units equipped with post-process pollutant control devices, with pre-control device emissions equal to or greater than 100 percent of the major source threshold for a pollutant, and subject to the Title V permit program. To comply with these requirements, a CAM Plan must be developed for each applicable pollutant emitted from each applicable emission unit. The focus of each CAM Plan is to ensure and document proper operation of the control device, thereby assuring compliance with the applicable emission limit.

#### 3.16.1.3 Regulations for Indirect Emissions

The proposed Project would contribute indirect emissions through the use of electric power supplied to the proposed Project for short-term and long-term activities associated with exploration, development, general construction, operations, maintenance, and reclamation of the mine. Indirect emissions also would result from water use because electric power is used to transfer water and from waste disposal (e.g., transportation, recycling, and landfilling).

Regulations and standards that govern indirect short-term and long-term emissions are mainly the regulations that electric utility generators must comply with, such as Title V Operating Permits and the Title IV Acid Rain Program, along with state and local rules and regulations applied as enforceable permit conditions. It should be noted that electric utility generators would be subject to different regulations than those applicable to the proposed Project.

### 3.16.2 Climate Change

The American Meteorological Society refers to *climate change* as any systematic change in the long-term statistics of climate elements (such as temperature, pressure, or winds) sustained over several decades or longer (AMS 2010). The Society indicates that climate change may be due to natural external forcings such as changes in solar emission or slow changes in the Earth’s orbital elements, natural internal processes of the climate system, or anthropogenic forcing (the direct influence of human activities on climate). The climate system also can be influenced by changes in the concentration of various GHGs in the atmosphere that affect the Earth’s absorption of radiation.

In its *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010*, USEPA provides summary information on the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Control (IPCC) (1990–2007) (USEPA 2012b). Key information from that report is summarized below.

The UNFCCC defined *climate change* as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC 2009). In its *Second Assessment Report* of the science of climate change, the IPCC concluded that "human activities are changing the atmospheric concentrations and distributions of greenhouse gases and aerosols. These changes can produce a radiative forcing by changing either the reflection or absorption of solar radiation, or the emission and absorption of terrestrial radiation" (IPCC 1995).

Building on this conclusion, the IPCC *Third Assessment Report* (IPCC 2001) asserted that "concentrations of atmospheric greenhouse gases and their radiative forcing have continued to increase as a result of human activities."

The IPCC reports that the global average surface temperature of the Earth has increased by 1.1 ± 0.4°F (0.6 ± 0.2 °C) over the 20th century. This value is approximately 0.27°F (0.15 °C) larger than that estimated by the *Second Assessment Report*, which reported for the period up to 1994, "owing to the relatively high temperatures of the additional years (1995 to 2000) and improved methods of processing the data."

While the *Second Assessment Report* concluded that "the balance of evidence suggests there is a discernible human influence on global climate," the *Third Assessment Report* more directly connects the influence of human activities on climate. The IPCC concluded, "In light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."

In its most recent report (the *Fourth Assessment Report*), the IPCC stated that warming of Earth's climate is unequivocal, and that warming is very likely attributable to increases in atmospheric GHGs caused by human activities (IPCC 2007). The IPCC further stated that changes in many physical and biological systems, such as increases in global temperatures, more frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts, are linked to changes in the climate system; and that some changes might be irreversible.

The principal GHGs are carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), $O_3$, and water vapor. Also included are man-made fluorinated gases—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$). Because $CO_2$ is the reference gas for climate change, measures of non-$CO_2$ GHGs are converted into $CO_2$-equivalent ($CO_2$-e) values based on their potential to absorb and trap heat in the atmosphere, referred to as *global warming potential* (USEPA 2012b). GHGs occur naturally because of volcanoes, forest fires, and biological processes (such as enteric fermentation [the digestive process for carbohydrates] and aerobic decomposition [decomposition of organic material with oxygen]). They are also produced by burning fossil fuels in power plants and automobiles, and from industrial processes, agricultural operations, waste management, and land use changes such as loss of farmland to urbanization.

### 3.16.3 Existing Conditions

#### 3.16.3.1 Climate

South Carolina's climate is influenced by the nearby Atlantic Ocean and Appalachian Mountains. The Atlantic Ocean generally moderates temperatures, with average annual temperatures varying between 50 and 60 °F (Schlumberger Water Services 2011). The region has a humid subtropical climate with hot, humid summers and mild, wet winters. July and August are the wettest months for average precipitation. South Carolina climate trends from 1895 to 2006 indicate that average annual temperatures have decreased approximately 0.5 °F, and average annual precipitation has increased approximately 3 inches (SCSCO 2008).

Annual snowfall is typically less than 6 inches per year, and thunderstorms and tornadoes occur on average approximately 50 and 15 days per year, respectively (Schlumberger Water Services 2011). The proposed Project is just outside of the FEMA-designated hurricane susceptibility region. Estimated wind speeds in the Project area could reach a maximum of approximately 200 mph during an extreme wind event (tornado or hurricane) (FEMA 2012).

#### 3.16.3.2 Ambient Air Quality

The SCDHEC operates several air quality monitoring stations throughout the state (SCDHEC 2012b). Data from these stations have been reviewed to represent background air quality in the study area. As not all pollutants are monitored at each site, data from a variety of stations are considered to be representative for the various monitored pollutants.

Monitoring stations along the coastal region were eliminated when determining the appropriate stations to use for existing air quality background at the inland Project. The currently available background concentrations (2008–2010) were obtained for $PM_{10}$, $PM_{2.5}$, $SO_2$, nitrogen dioxides (NOx), and CO from the SCDHEC's website (Tetra Tech 2012). All of the data indicate that the air quality in the region is generally good, hence the NAAQS attainment status as described below. Table 3.16-2 provides the most recent summary data available from the monitoring network considered representative for the various pollutants in the study area.

#### 3.16.3.3 Air Quality Attainment Status

The only NAAQS nonattainment area in South Carolina is York County, west of Lancaster County, which is designated as marginal nonattainment of the 8-hour ground-level ozone standard (USEPA 2012c). The proposed Project is located in Lancaster County, near the Lancaster/Kershaw county line. Both Kershaw and Lancaster Counties are designated as NAAQS attainment/unclassified for all criteria pollutants; therefore, the proposed Project does not require a General Conformity Determination.

As shown in Table 3.16-2, no federal standards were exceeded in the study area during the monitoring period (2008–2010).

#### 3.16.3.4 Sensitive Receptors

Certain population groups are considered more sensitive to air pollution and odors than others—in particular, children, the elderly, and acutely ill and chronically ill persons, and especially those with cardio-respiratory diseases such as asthma and bronchitis. Sensitive receptors (land uses) include locations where such individuals are typically found, namely schools, daycare centers, hospitals, convalescent homes, residences of sensitive persons, and parks with active recreational uses such as youth sports. The USEPA and several state- and county-level public health agencies provide guidance and definitions for sensitive receptors. Figure 3.16-2 depicts sensitive receptors in the study area.

**Table 3.16-2 Existing Ambient Air Quality Background Concentrations in the Study Area**

| Pollutant | Averaging Time | Background | | NAAQS | |
|---|---|---|---|---|---|
| | | ppmv | µg/m³ | ppmv | µg/m³ |
| Ozone ($O_3$) | 8-hour | 0.068 | 144 | 0.075 | 147 |
| Nitrogen dioxide ($NO_2$) | 1-hour | 0.040 | 75.2 | 0.100 | 188 |
| | Annual | 0.005 | 9.8 | 0.053 | 100 |
| Sulfur dioxide ($SO_2$) | 1-hour | 0.044 | 115.2 | 0.075 | 196 |
| | 3-hour | 0.033 | 86.1 | 0.5 | 1,309 |
| Carbon monoxide (CO) | 1-hour | 1.8 | 2,022 | 35 | 40,072 |
| | 8-hour | 1.2 | 1,412 | 9 | 10,304 |
| Particulates (as $PM_{10}$) | 24-hour | — | 33 | — | 150 |
| Particulates (as $PM_{2.5}$) | 24-hour | — | 20 | — | 35 |
| | Annual | — | 10.3 | — | 15 |
| Lead (Pb) | 3-month rolling | — | 0.006 | — | 0.15 |

Notes:

ppmv = parts per million by volume
µg/m³ = micrograms per cubic meter

There is no ppmv standard for $PM_{10}$, $PM_{2.5}$, and Pb and, therefore, no background values.

Sources: SCDHEC 2012c; USEPA 2012a.

Persons engaged in strenuous work or physical exercise also have increased sensitivity to poor air quality. Residential areas are considered more sensitive to air quality conditions than commercial and industrial areas because people generally spend longer periods of time at their residences, resulting in greater exposure to ambient air quality conditions. Recreational uses, such as parks, are also considered sensitive because of the greater exposure to ambient air quality conditions and because the presence of pollution detracts from the recreational experience.

EO 13045 specifically protects children from environmental health risks and safety risks. It encourages federal agencies to prioritize identification and assessment of environmental health risks and safety risks that may disproportionately affect children and ensure that agency policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks (see Sections 3.10 and 4.10, "Socioeconomics and Environmental Justice" for additional discussion).

### 3.16.3.5 Greenhouse Gases

Nationally, $CO_2$ emissions from fossil fuel combustion represented the largest source (approximately 80 percent) of total weighted GHG emissions from all emission sources in 2007 (USEPA 2012b). Table 3.16-3 shows aggregated net U.S. and South Carolina emissions of $CO_2$-e for all sources and sinks (a natural area or feature that acts as a reservoir for $CO_2$). As indicated, South Carolina accounts for less than 2 percent of $CO_2$-e emissions in the United States annually (CCS 2008). Due to economic growth, however, South Carolina's net GHG emissions have effectively doubled since 1990 while nationwide GHG emissions increased by approximately 9 percent overall in the same period.

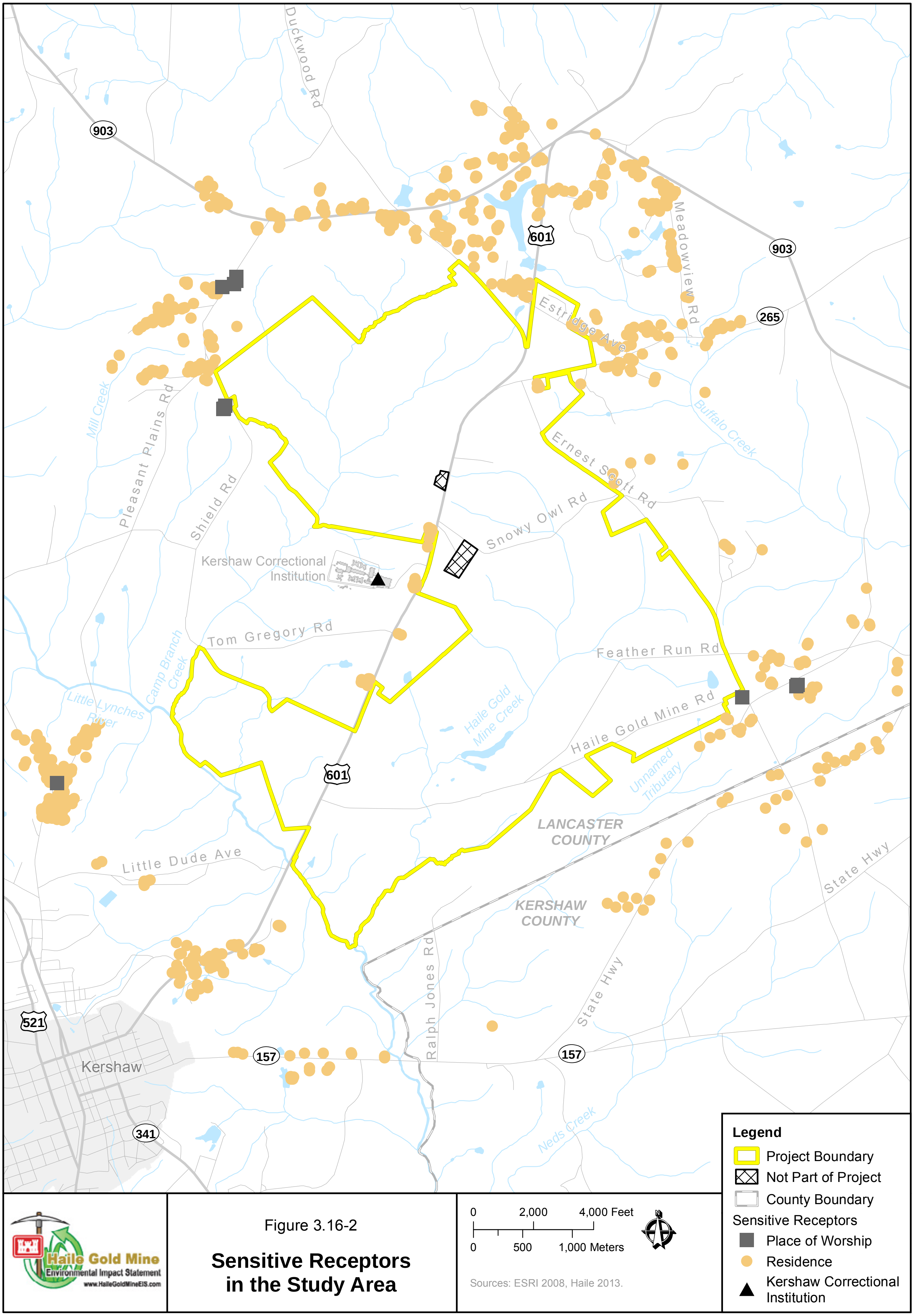


Figure 3.16-2

**Sensitive Receptors in the Study Area**

Sources: ESRI 2008, Haile 2013.

**Table 3.16-3 Total Estimated Net GHG Emissions for South Carolina and the United States**

| Summary Year | Net $CO_2$-e (sources minus sinks) | |
|---|---|---|
| | South Carolina (million metric tonnes) | United States (million metric tonnes) |
| 1990 | 34 | 5,293 |
| 2005 | 62 | 6,118 |
| 2010 | 71 | 5,747 |

Notes:

1 metric tonne = 1,000 kilograms or 2,204.6 pounds (1.1023 short tons)

$CO_2$-e = carbon dioxide equivalents

GHG = greenhouse gas

Values are rounded to the nearest whole number (integer).

Sources: USEPA 2012b; CCS 2008.

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# 3.17 Noise and Vibration

The Project would contribute to the existing noise environment through the use of on-road vehicles, off-road equipment, and stationary equipment during exploration, development, construction, operations, maintenance, and reclamation of the mine. The Project would cause ground-borne vibrations from the use of on-road, off-road, mobile, and stationary equipment and from blasting activity during exploration, development, construction, operations, maintenance, and reclamation of the mine.

Potential impacts could result from the proximity of Project noise sources to sensitive receptors, typical noise levels associated with equipment, the potential for noise levels to interfere with daytime and nighttime activities, and the duration that sensitive receptors would be affected. Sensitive receptors are land uses that can be more sensitive to noise based on the population groups present or activities involved.

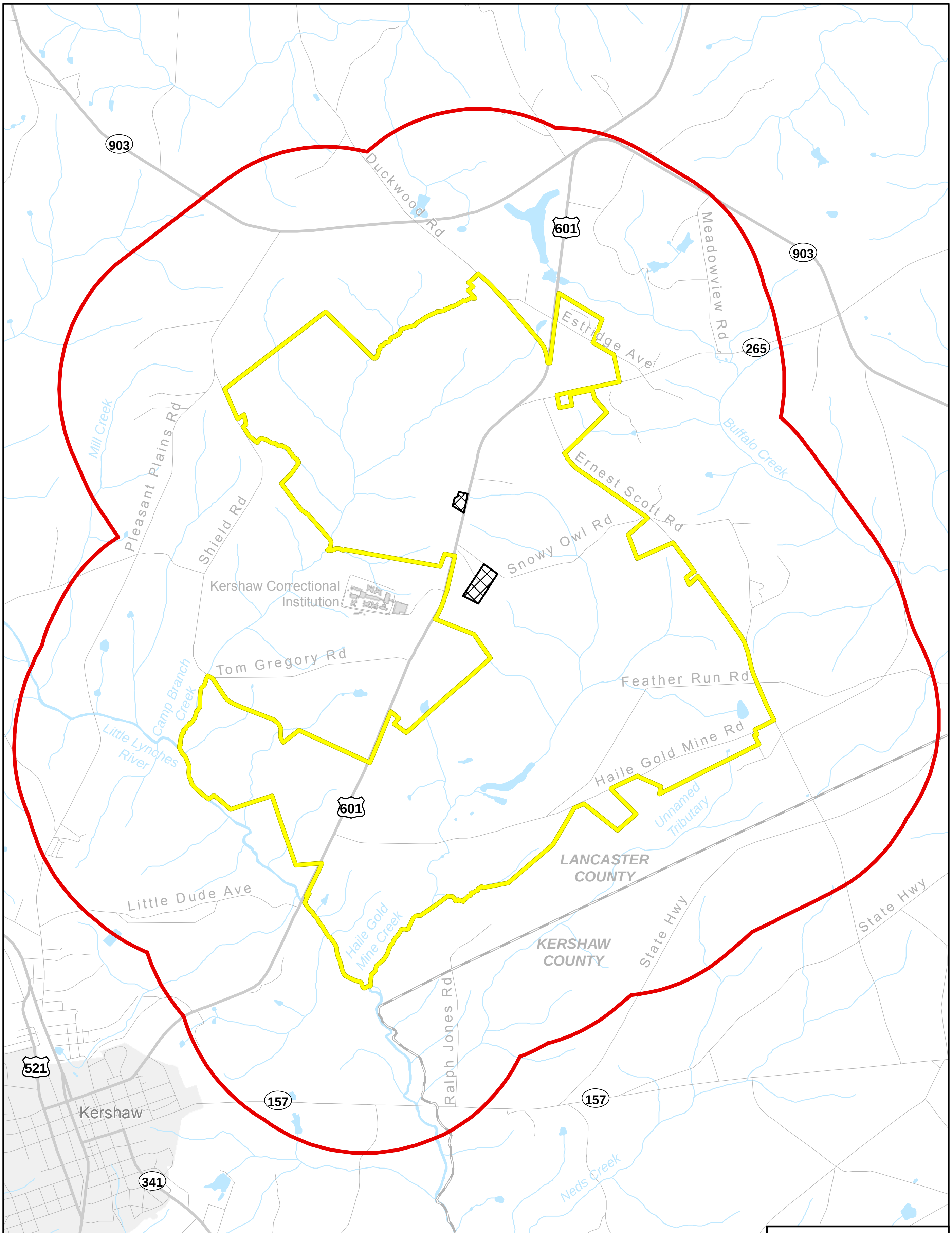
The study area for noise and vibration impacts extends 1 mile beyond the Project boundary, as shown in Figure 3.17-1.

## 3.17.1 Noise Terminology and Thresholds

*Sound* is mechanical energy transmitted by pressure waves in a compressible or incompressible medium, such as air or water, respectively (FTA 2006). Sound is a fluctuation of air pressure, and the number of times the fluctuation occurs in a second is known as *frequency*. Some sounds, like whistles, are associated with a single frequency and known as a *pure tone*. Usually, sound is made up of many frequencies, all blended together. When sound becomes excessive, annoying, or unwanted, it is referred to as *noise*. Noise levels are quantified using units of decibels (dB). Noise may be continuous (constant noise with a steady decibel level), steady (constant noise with a fluctuating decibel level), impulsive (a high peak of short duration), stationary (occurring from a fixed source), intermittent (occurring at the same rate), or transient (occurring at different rates).

Figure 3.17-2 depicts noise levels for common sounds. The following examples are typical decibel levels for common sounds measured at a typical distance from the source (Plog 1988):

- Rocket launch: 160 dB
- Military jet plane takeoff: 150 dB
- Threshold of pain: 140 dB
- Commercial jet plane takeoff: 130 dB
- Industrial chipper or punch press: 120 dB
- Loud automobile horn: 110 dB
- Passing diesel truck: 100 dB
- Factory – heavy manufacturing: 90 dB
- Factory – light manufacturing: 80 dB
- Open floor office – cubicles: 70 dB
- Conversational speech: 60 dB
- Private office – walled: 50 dB
- Residence in daytime: 40 Db
- Bedroom at night: 30 dB
- Recording or broadcasting studio: 20 dB
- Threshold of good hearing – adult: 10 dB
- Threshold of excellent hearing – child: 0 dB




3.17-1

**Noise and Vibration Study Area**



Source: ESRI 2008.

**Legend**

- Project Boundary
- Not Part of Project
- Noise and Vibration Study Area
- County Boundary

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| INDOORS | Noise Level (dBA, Leq) | OUTDOORS |
|---|---|---|
| Rock Band | | |
| | 110 | |
| | | Widebody Aircraft Departure Flyover (at 1,000 ft.) |
| | 100 | |
| Inside Subway Train (New York) | | |
| | | Gas Lawn Mower (at 3 ft.) |
| | 90 | |
| Food Blender (at 3 ft.) | | Diesel Truck (at 50 ft.) |
| Garbage Disposal (at 3 ft.) | | Noisy Urban Daytime |
| | 80 | |
| Vacuum Cleaner (at 10 ft.) | | Gas Lawn Mower (at 100 ft.) |
| | 70 | |
| | | Commercial Area |
| Speech (at 3 ft.) | | Heavy Traffic (at 300 ft.) |
| | 60 | |
| Large Business Office | | |
| | | Quiet Urban Daytime |
| | 50 | |
| Dishwasher (Next Room) | | |
| Small Theater | | Quiet Urban Nighttime |
| | 40 | |
| Large Conference Room (Background) | | |
| Library | | Quiet Suburban Nighttime |
| | 30 | |
| Concert Hall (Background) | | Quiet Rural Nighttime |
| | 20 | |
| Broadcast & Recording Studio | | |
| | 10 | |
| Threshold of Hearing | | |

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Figure 3.17-2

**Noise Levels for Common Sounds**

Source: Sacramento County Airport System 2014.

Two measurements used by local, state, and federal agencies that relate the time-varying quality of environmental noise to its known effect on people are (1) the 24-hour equivalent sound level ($L_{EQ}$[24]); and (2) the day-night sound level ($L_{DN}$). The $L_{EQ}$(24) is the level of sound with the same energy as the time-varying sound of interest, averaged over a 24-hour period. The $L_{DN}$ is the $L_{EQ}$(24) with 10 decibels on the A-weighted decibel scale (dBA) (the equivalent constant sound level for a varying sound level measured over a period of time) added to nighttime sound levels between the hours of 10 p.m. and 7 a.m., to account for people's greater sensitivity to sound during nighttime hours. The 10th percentile-exceeded sound level ($L_{10}$) is the A-weighted sound level that is exceeded 10 percent or more of the time of the measurement (USEPA 1974). Other measures include $L_{50}$ and $L_{90}$, which represent sound levels that are exceeded 50 percent and 90 percent or more of the time of the measurement, respectively.

In 1974, the USEPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This document provides information for state and local agencies to use in developing their ambient noise standards. In the USEPA document, the agency identified outdoor and indoor noise levels to protect public health and welfare. An $L_{EQ}$(24) of 70 dBA was identified as the level of environmental noise that would not result in any measurable hearing loss over a lifetime. An $L_{DN}$ of 55 dBA outdoors and an $L_{DN}$ of 45 dBA indoors were identified as noise thresholds that would prevent activity interference or annoyance. These levels are not "peak" levels but are 24-hour averages over several years; occasional high levels of noise may occur. An $L_{DN}$ of 55 dBA is equivalent to a continuous noise level of 48.6 dBA. Examples of typical noise levels measured at a typical distance from the source are as follows (USEPA 1974):

- Grass trimmer: 94–96 dBA
- Hair dryer: 80–95 dBA
- Garbage disposal: 76–83 dBA
- Telephone ringer: 66–75 dBA
- Clothes washer: 65–70 dBA
- Clothes dryer: 56–58 dBA
- Microwave oven: 55–59 dBA
- Forced hot air heating system: 42–52 dBA
- Refrigerator: 40–43 dBA
- Computer room: 37–45 dBA
- Quiet room: 28–33 dBA

Increases in noise measured on the A-weighted decibel scale can have the following effects on humans (USEPA 1974):

- A change of 1 dBA cannot be perceived by humans, except in carefully controlled laboratory environments;
- Outside of the laboratory, a 3-dBA change is considered a just-perceivable difference by humans;
- A change of at least 5 dBA is required before any noticeable change in human response would be expected; and
- A 10-dBA change is subjectively heard as approximately a doubling in loudness and can cause an adverse response.

In most areas, transportation sources such as automobiles, trucks, trains, and aircraft are the principal sources of ambient noise. Industrial and commercial equipment operations and wind-related sounds also contribute to the ambient noise environment in their vicinities. According to the National Institutes of Health, National Institute on Deafness and Communication Disorder, noise-induced hearing loss (NIHL) can occur when one is exposed to harmful noise. Brief exposure to sounds that are very loud or longer-term exposure to fairly loud sounds can cause damage to the sensitive structures of the inner ear, called *hair cells*. Once damaged, the hair cells cannot grow back, resulting in permanent NIHL (NIDCD 2008).

Sources of noise that can cause NIHL include loud motorcycles, firecrackers, and small firearms—all emitting sounds from 120 to 150 dBA. In addition, long or repeated exposure to sounds at or above 85 dBA can cause hearing loss, such as in an industrial setting. The louder the sound, the shorter the time period for NIHL to occur. Sounds of less than 75 dBA, even after long exposure, are unlikely to cause significant hearing loss. In populated areas, excessive noise levels of 90 to 110 dBA, which are typical during jet flyovers at 1,000 feet or a diesel truck at 50 feet, commonly result in complaints to civic authorities. Although being aware of decibel levels is an important factor in protecting one's hearing, distance from the source of the sound and duration of exposure to the sound are equally important (NIDCD 2008).

Noise also varies with distance. As an example, typical highway traffic 50 feet from a receptor typically produces sound levels of approximately 70 dBA. The same highway noise measures 66 dBA at a distance of 100 feet, assuming soft ground conditions (as opposed to a hard surface such as rock). This decrease is known as attenuation. The outdoor attenuation rate for line sources, such as traffic, is a decrease of approximately 4.5 dBA (for soft ground) for every doubling of distance between the source of noise and the receptor (for hard ground, the outdoor drop-off rate is 3 dBA for line sources). Assuming soft ground, for point sources such as amplified music or speech, the outdoor attenuation rate is a decrease of approximately 7.5 dBA for every doubling of distance between the noise source and receptor (for hard ground, the outdoor attenuation rate is 6 dBA for point sources).

### 3.17.2 Vibration Terminology and Thresholds

*Vibration* is energy transmitted in waves through the soil (FTA 2006). These energy waves generally dissipate with distance from the vibration source (e.g., pile driving, blasting). Because energy is lost during the transfer of energy from one particle to another, vibration that is distant from the source is usually less perceptible than vibration closer to the source. Actual human and structural response to different vibration levels is influenced by a combination of factors, including soil type, distance between the source and receptor, duration, and the number of perceived events.

If great enough, the energy transmitted through the ground as vibration can result in structural damage to buildings. To assess the potential for structural damage associated with vibration, the vertical and horizontal vibratory ground motion (known as the *peak vector sum*) in the vicinity of the affected structure is measured as point peak velocity (PPV), typically in units of inches per second. A *vector* is a quantity having direction as well as magnitude, and a *vector sum* is the addition of two or more vectors. In this case, the vectors are noise in the vertical and horizontal directions. A freight train passing at 100 feet can cause PPVs of 0.1 inch per second, while a strong earthquake can produce PPVs in the range of 10 inches per second. Minor cosmetic damage to buildings can begin in the range of 0.5 inch per second.

Another unit of measure for vibration is vibration decibels (VdB). Ground-borne vibration consists of rapidly fluctuating motions within the ground that have a net motion of zero. The effects of ground-borne vibrations typically cause a nuisance only to people, but damage to buildings may occur at extreme vibration levels. Although ground-borne vibration can be felt outdoors, it is typically an annoyance only to people indoors, where the associated effects of the shaking of a building can be notable and because people are moving around less indoors (e.g., seated). Induced ground-borne noise is an effect of ground-borne vibration and exists only indoors because it is produced from noise radiated from the motion of the walls and floors of a room and may consist of rattling of windows or dishes on shelves. Although the perceptibility threshold is approximately 65 VdB, human response to vibration is not usually significant unless the vibration exceeds 70 VdB. The threshold of potential architectural damage to fragile (e.g., old masonry) structures is approximately 100 VdB.

Human response to different levels of ground-borne noise and vibration are as follows (FTA 2006):

- 65 VdB produces a noise level between 25 (low frequency) and 40 dBA (high frequency) and is the approximate threshold of perception for many humans. The low-frequency level is usually inaudible; the mid-frequency sound is excessive for quiet sleeping areas.
- 75 VdB produces a noise level between 35 (low frequency) and 50 dBA (high frequency). These levels range between barely perceptible and distinctly perceptible. Many people find transit vibration (e.g., passing trains) at this level annoying. The low-frequency level is acceptable for sleeping areas; the mid-frequency noise is annoying in most quiet, occupied areas.
- 85 VdB produces a noise level between 45 (low frequency) and 60 dBA (high frequency). Vibration at these levels is acceptable only with an infrequent number of events per day. The low-frequency noise is annoying for sleeping areas; the mid-frequency noise causes annoyance for institutional land uses, such as schools and churches, even with infrequent events.

As discussed below, the regulatory standards used to analyze noise in Section 4.17 are in units of PPV.

### 3.17.3 Regulatory Setting

*Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (USEPA 1974) provides guidance for state and local agencies to use in developing their ambient noise standards. Noise thresholds at or below an outdoors $L_{DN}$ of 55 dBA and an indoors $L_{DN}$ of 45 dBA have been identified as noise thresholds that would prevent activity interference or annoyance.

The U.S. Bureau of Mines (USBM) *Report of Investigation 8507* and *Report of Investigation 8485* (USBM 1980a, 1980b) and the Federal Transit Administration (FTA) *Ground-Borne Vibration Impact Criteria for General Assessment* (2006) address vibration effects. For low-frequency vibrations, the USBM determined a limit of 0.50 inch per second PPV for plaster and 0.75 inch per second PPV for modern drywall. Concrete block, masonry, and concrete are much less susceptible to damage by short-term vibration effects, with applicable limits generally in excess of 3.00 inches per second PPV. The USBM also specifies a maximum safe overpressure of 0.013 pound per square inch (psi) (133 dB) for impulsive airblast.

The FTA (2006) provides vibration standards for structural damage based on a building's structure. For buildings constructed of non-engineered timber or masonry, including reinforced-concrete, steel, or timber (no plaster), the limit is 0.5 inch per second PPV; for engineered concrete and masonry (no plaster) the limit is 0.3 inch per second PPV; for non-engineered timber and masonry buildings, the standard is 0.2 inch per second PPV; and for buildings extremely susceptible to vibration damage, the standard is 0.12 inch per second PPV.

The following state regulations apply to the Project:

- South Carolina Code of Regulations, Chapter 89, Section 89-120 *Terms and Conditions of Permit, Noise Monitoring and Control* requires applications for mining operations that may significantly increase noise to include monitoring for background noise levels as follows:

  On initial applications or permits with substantial modifications where the SDHEC determines that a mining operations may significantly increase noise levels on neighboring property, the operator may be required to conduct monitoring to determine background noise levels; and information collected from the noise monitoring will be used by the operator and Department to determine provisions to minimize noise levels to neighboring landowners.

- South Carolina Code of Regulations, Chapter 89, Section 89-150 *Surface Blasting Requirements* details blasting operations procedures for mining facilities. These requirements include, but are not limited to, pre-blast surveys, notification, recordkeeping, maximum peak particle velocity, and minimum distance from receptors and property boundaries.

Some local governments define sensitive receptors in their General Plan noise elements; however, Lancaster County does not include a definition in its *Comprehensive Plan*. Regulations and standards that would govern Project-related noise contributions include the Lancaster County Code of Ordinances, including Part I, Chapter 23, Article II *Noise* and Part I, Appendix B, Chapter 4, Conditional and Special Exceptional Uses, Section 4.1.16, *Manufacturing/Processing Uses*. The ordinance states,

> *All noise shall be muffled so as not to be objectionable due to intermittence, beat frequency or shrillness" and includes standards for residential and non-residential noise levels (from -5 dBA to +10 dBA increases and from 20 to 69 dB depending on frequency) and standards for daytime and nighttime vibration (from 0.01 to 0.06 inch per second PPV).*

### 3.17.4 Existing Conditions

#### 3.17.1.1 Ambient Sound Level

The ambient sound level of a region is defined by the total noise generated within the specific environment and is usually comprised of mixed sounds emanating from natural and artificial sources from many directions. Current and anticipated land uses in the Project area are described in Sections 3.11 and 4.11, "Land Use," respectively. The magnitude and frequency of environmental noise associated with a specific land use may vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover. The existing noise levels in the Project area are described below.

Sensitive receptors are those populations that are more susceptible to or more likely to be disturbed or affected by noise than the general population. Sensitive population groups include children and the elderly. Some land uses are generally regarded as being more sensitive to noise than others due to the types of population groups, aesthetic considerations, or activities involved. Sensitive land uses generally include residences, hospitals, schools, child care facilities, senior facilities, libraries, churches, botanical and zoological gardens, parks, and correctional facilities.

Figure 3.17-3 identifies sensitive receptors within 1 mile of the Project boundary. No hospitals or medical centers, libraries, schools, child or senior care facilities, or parks are located within the 1-mile radius. There are 723 residences, 11 places of worship, and one correctional facility within the 1-mile radius.

Noise and vibration levels at the receptors nearest Project-related activities would represent a worst-case scenario for noise and vibration impacts because these levels decrease with distance. Beyond certain distances, noise and vibration levels would attenuate below perceptibility.

South Technical Services LLC (STS) collected background noise measurements for the Project in September and October 2010 (2012). The noise measurement locations are illustrated in Figure 3.17-4. STS conducted long-term noise measurements (24-hour sound monitoring) at two locations: the Haile Gold Mine Baptist Church and Kershaw Industrial Park. On October 5, 2010, STS placed a 24-hour sound monitoring station along Haile Gold Mine Road. The station was left in place until the next site visit on October 14, 2010. During this time, the equipment was tampered with, resulting in the sound meter recording data only through October 11, 2010. Further monitoring took place on October 20 and 22, 2010, for a full day. STS gathered 9 total days of measurements at the Haile Gold Mine Baptist Church location. STS also conducted 24-hour sound monitoring at Kershaw Industrial Park on October 5 and October 21, 2010.

Additional spot-duration noise measurement sessions were performed on October 20 and 22, 2010, at the corner of Gold Mine Highway and Haile Gold Mine Road, along Haile Gold Mine Road, at the corner of Snowy Owl Road and SR 219, at residences along Snowy Owl Road, at the corner of Snowy Owl Road and Gold Mine Highway, and at the intersection of Gold Mine Highway and SR 265. STS monitored sound at each of these locations for 2 hours on the following days: September 21 and 27; and October 5, 6, 20, 21, and 22, 2010.

The noise measurements were taken and subsequently analyzed using two QuestSoundPro SE/DL meters. These meters have two virtual sound level microphones to simultaneously measure multiple regulatory requirements or sound scales. For this study, the sound meters were programmed to record a flat or impulse scale and an A-weighted decibel scale to simulate human response.

Table 3.17-1 shows background levels for each noise monitoring location, on an average basis over a 1-hour duration. The average ambient sound levels ranged from 44.6 to 63.6 dB. This range of sound levels is considered typical for this type of environment (generally below 75 dB) and the existing land uses (STS 2012).

#### 3.17.1.2 Vibration Levels

Vibration sources in an area with both residential and industrial use, such as the Project area, include truck and vehicle traffic and industrial operations. Vibration levels are not typically measured for background information; expected vibration levels are calculated for the various phases of a project, as will be done for the Project operations. Vibration impact criteria do not take existing vibration levels into account. Typically, the existing environment does not include a significant number of perceptible ground-borne vibration events (which is true for the Project area). When a project would result in vibration levels greater than 5 VdB over the existing source, the existing source is not considered, and standard vibration criteria are applied (FTA 2006).

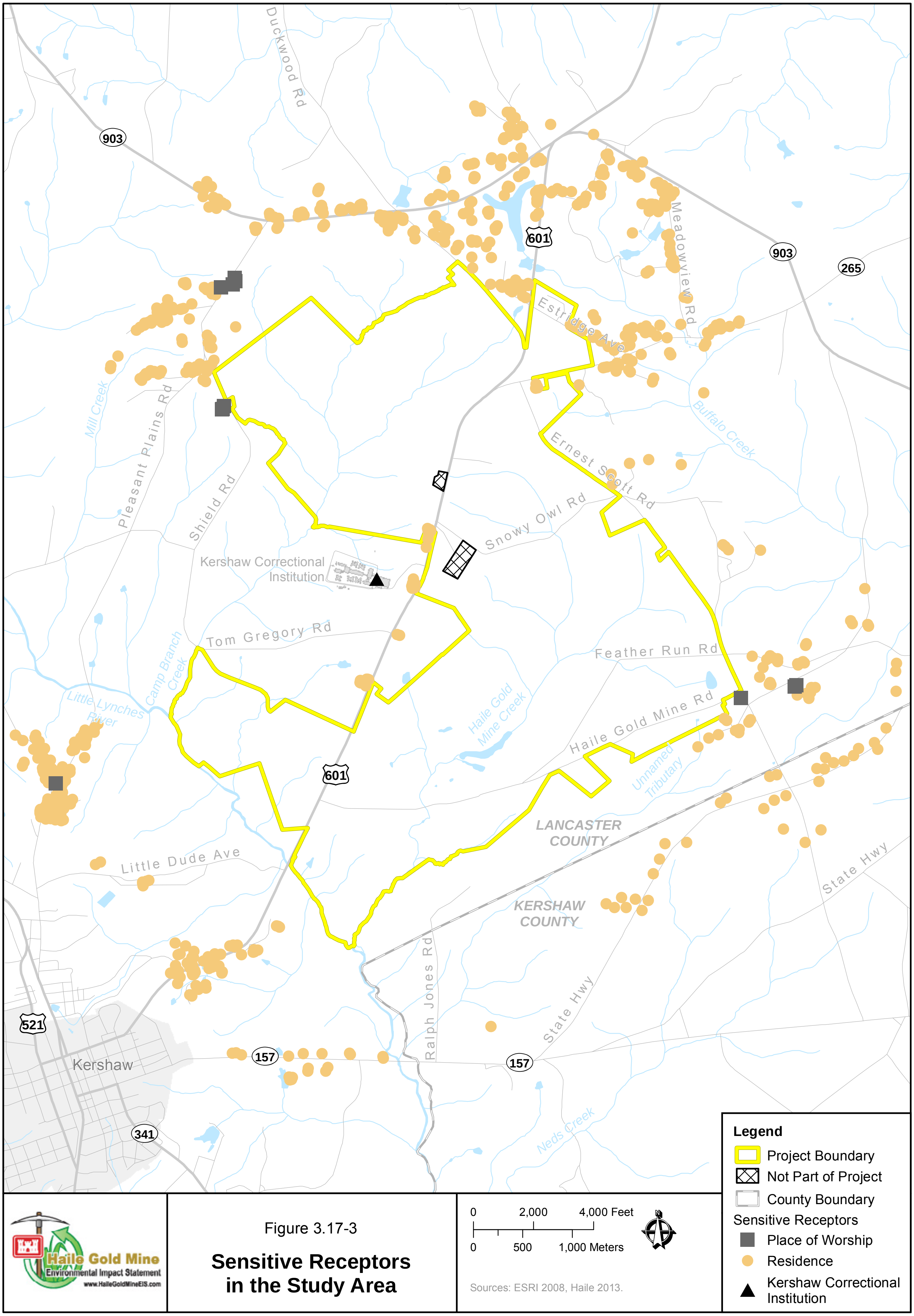


Figure 3.17-3

**Sensitive Receptors in the Study Area**

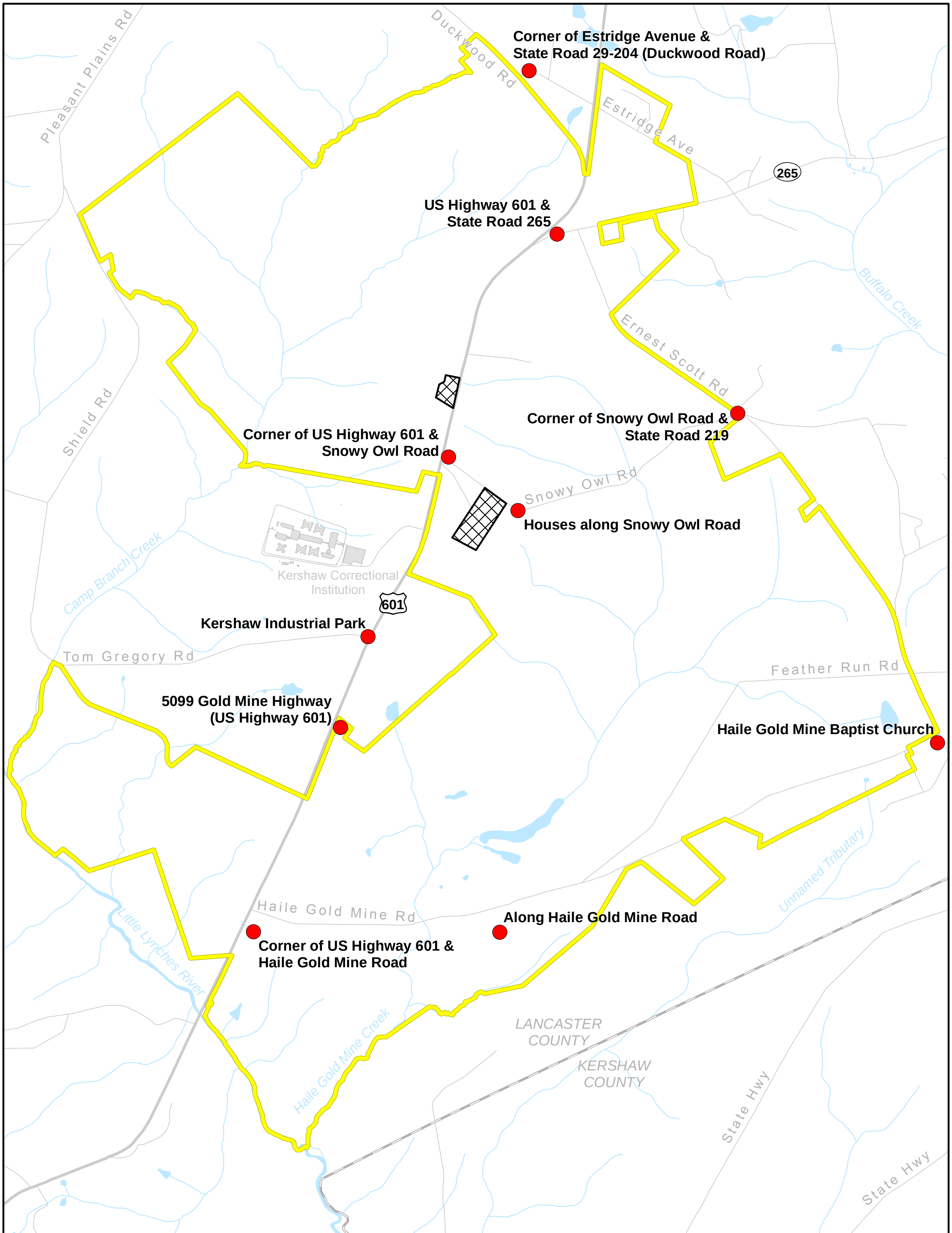


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Figure 3.17-4

**Noise Measurement Locations in the Study Area**

0 1,000 2,000 Feet
0 300 600 Meters

Sources: ESRI 2008, Haile 2013.

**Legend**
- Project Boundary
- Not Part of Project
- Noise Measurement Locations
- County Boundary

**Table 3.17-1 Background Noise Levels at Monitored Locations in the Study Area**

| Measurement Location | Mid-Morning Noise (dBA) [a, b] | | Late Afternoon/Early Evening Noise (dBA) [a, b] | |
|---|---|---|---|---|
| | Average | Peak | Average | Peak |
| Haile Gold Mine Baptist Church | 49.7 | 63.6 | 44.6 | 58.5 |
| Kershaw Industrial Park | 56.6 | 68.1 | 52.4 | 63.1 |
| Corner of Gold Mine Highway and Haile Gold Mine Road | 63.6 | 76.5 | 57.9 | 69.8 |
| Along Haile Gold Mine Road | 56.6 | 68.1 | 52.4 | 63.1 |
| Corner of Snowy Owl Road and State Road 219 | 58.1 | 64.5 | 54.1 | 59.2 |
| Residences along Snowy Owl Road | 49.1 | 69.8 | 50.2 | 65.1 |
| Corner of Snowy Owl Road and Gold Mine Highway | 56.6 | 71.6 | 55.1 | 63.2 |
| Gold Mine Highway and State Road 265 | 60.9 | 72.7 | 58.0 | 62.4 |

dBA = A-weighted decibel level

[a] Measurements shown are A-weighted averages and peaks in lower (L)-$L_{EQ}$ (1-hour) duration.

[b] Mid-morning measurements generally were taken between 11:00 a.m. and 1:00 p.m. Late afternoon/early evening measurements generally were taken between 2:00 and 3:00 p.m., and between 4:00 and 5:00 p.m., respectively.

Source: STS 2012.

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# 3.18 Health and Safety

Health and public safety are primary considerations for any project. Failure to provide safe working conditions and appropriate site security (physical measures as well as human resources) can result in human injury and, potentially, fatalities. This section focuses on three health and public safety issues for the Project:

- Hazards from Project facilities. These can include worker accidents and injuries from the operation of vehicles and equipment; contact with chemicals; drilling, blasting, and loud equipment; and other Project facilities such as pits and pit lakes.
- Natural hazards, which refer to reasonable and foreseeable environmental conditions that could compromise the safety and stability of engineered components of the mine, as well as the surrounding natural environment associated with the Project. Potential natural hazards include environmental events, such as excessive precipitation, drought, freezing conditions, and wildland fires. Potential impacts related to natural hazards could include tailings dam breaks; flooding of Project facilities, pits, and equipment; facility failures; and wildland fires.
- Emergency response, or the ability of local and regional agencies to provide support services (e.g., fire, emergency medical, and police) when needed, in a timely manner. Potential impacts related to emergency response may include exceedance of the community's capacity to provide some types of emergency services and response times.

Project facilities that may be potentially hazardous include mine pits, the Mill and hazardous material storage areas, the Duckwood TSF, Johnny's PAG, the water treatment plant, piles of construction materials in laydown and temporary construction areas, water storage and sediment detention ponds, and trucks and heavy equipment. Potential impacts related to natural hazards include flooding of Project facilities, pits, and equipment; tailings dam breaks; and facility failures. Potential emergency service response impacts include exceedance of the community's capacity to provide emergency responses. The study area for health and safety is the Project area and the emergency response provided to the Project area by medical, fire, police, and other services and agencies.

Other sections of this EIS address a wide variety of resource-specific health and safety concerns, including:

- Seismic hazards and geotechnical considerations (Sections 3.2 and 4.2, "Geology and Soils");
- Pit wall slope stability (Sections 3.2 and 4.2, "Geology and Soils");
- Water quality (Sections 3.3 and 4.3, "Groundwater Hydrology and Water Quality" and 3.4 and 4.4, "Surface Water Hydrology and Water Quality");
- Water supply and flooding (Sections 3.5 and 4.5, "Water Supply and Floodplains");
- Protection of children from environmental health risks and safety risk in compliance with EO 13045 (Sections 3.10 and 4.10, "Socioeconomics and Environmental Justice");
- Transportation (Sections 3.12 and 4.12, "Transportation");
- Air quality (Sections 3.16 and 4.16, "Air Quality");
- Noise and vibration (Sections 3.17 and 4.17, "Noise and Vibration"); and

- Hazardous waste releases from transportation of hazardous materials to and from the Project area and releases from handling of materials in the Project area (Sections 3.19 and 4.19, "Hazardous Materials and Waste").

### 3.18.1 Regulatory Setting

The following federal and state regulations govern mining operations. See Appendix F for further details on regulations that apply to the Project.

- **Mine Safety and Health Administration –** The Mine Safety and Health Administration (MSHA) is an agency within the U.S. Department of Labor that administers the rules and regulations contained in the federal Mine Safety and Health Act (the Mine Act), Public Law (PL) 91-173, as amended by PL 95-164. The MSHA ensures compliance with the Mine Act by enforcing mandatory safety and health standards intended to protect workers in mine, mill, and other facilities. Federal metal mine safety and health regulations require mandatory training for all full-time employees. Compliance and worker safety includes regularly scheduled physicals/medical exams for miners, known as a *medical surveillance program*; on-site investigations; and testing and certification of personal protective equipment and hazard measurement equipment. Mining employees are required to obtain MSHA training certification under MSHA Part 46/48 for new miners, and annual refresher training is required to maintain certification.
- **South Carolina Mining Act –** At the state level, the SCDHEC is responsible for administering the provisions and requirements of the SCMA (Code of Laws Title 48, Chapter 20). Completion of Form MR-400, Application for a Mine Operating Permit, is required under the SCMA as part of the permitting process. Section V of Form MR-400 requires the applicant to describe the methods that will be implemented during mine operations to prevent physical hazards to persons and to any neighboring dwelling, house, school, church, hospital, commercial or industrial building, or public road.
- **South Carolina Mining Regulations: Chapters 89-10 through 89-350 –** SCDHEC regulations Chapters 89-10 through 89-350 describe the Mining Council of South Carolina regulations with statutory authority from the SCMA (48-20-10 and 48-20-210). Chapter 89-120.B.(4) describes the authority of the SCDHEC to impose terms and conditions on the mine operating permit, including plans to ensure public safety. Chapter 89-140 describes the minimum environmental protection standards that must be maintained during the time the permit is active. It describes safety requirements to prevent access to potentially dangerous areas on a project site.

Implementation and enforcement of safety policies and procedures reduce the risks to mine workers and the public within the Project boundary. Proper training of all personnel on the Project site is required by the SCMA and MSHA regulations. Based on health and safety risk assessments, safety protocols, and MSHA regulations, all employees receive safety training applicable to their work area and level of risk. This training includes, but is not limited to, personal protection equipment, first aid/heat stress/cold weather awareness, accident prevention, fire incident management, fall protection, and MSHA Part 48 training (which requires that any employee or contractor working onsite for more than 5 days within a 12-month period must receive no less than 24 hours of training before they are assigned to work duties). Annual refresher training (8-hour) is required after 1 year. By regulation, MSHA-approved instructors teach all courses. For a complete list of training courses provided, refer to Appendix G in the Applicant's Solid and Hazardous Waste Management Plan (Haile 2011).

### 3.18.2 Existing Conditions

This section describes the existing natural hazards and emergency response capabilities in the Project area.

#### 3.18.2.1 Project Facilities

Construction and operation of mining and other heavy industrial facilities involve a features and activities that can expose workers to potential injuries, illnesses, or fatalities. Federal and state labor agencies collect statewide injury/illness and fatality data by industrial labor category (Table 3.18-1). The average number of days away from work due to illness or injury for the South Carolina mining and natural resource industry was 180 days with an average of 6 fatalities per year. It should be noted that mining injuries/illnesses and fatalities are reported as part of a greater natural resources and mining industry labor category, thus representing an overstatement of potential recordable incidents for mining only, and instead providing an indicator about the levels of incidents.

**Table 3.18-1 Number of Nonfatal Occupational Injuries, Illnesses, and Fatalities in the Mining and Natural Resources Industry in South Carolina (2008–2012)**

| Year | Nonfatal Occupational Injuries and Illnesses | | Total Occupational Fatalities | Fatality Event or Exposure | | |
|---|---|---|---|---|---|---|
| | Total Recordable Cases | Cases with Days Away from Work | | Contacts with Objects and Equipment | Exposure to Harmful Substances or Environments | Transportation Incidents |
| 2012 | 500 | 300 | 6 | - | 3 | 3 |
| 2011 | 400 | 200 | 4 | - | - | 4 |
| 2010 | 200 | 100 | 7 | - | - | 6 |
| 2009 | 200 | 100 | 6 | - | - | - |
| 2008 | 400 | 200 | 7 | 5 | - | - |
| **Annual Average** | **340** | **180** | **6** | **-** | **-** | **-** |

Source: BLS 2013.

#### 3.18.2.2 Natural Hazards

Potential natural hazards include severe weather events and conditions, such as excessive precipitation events, prolonged freezing conditions, and wildland fires. The *Lancaster County Hazard Mitigation Plan* (Lancaster County 2012) provides an assessment of specific natural hazards that affect the county and addresses the vulnerabilities of those hazards on specific communities. This plan documents natural hazards that historically have caused major damage in Lancaster County, including flooding, tropical storms, severe thunderstorms, tornadoes, winter storms, and wildfires. A summary of this information is provided below.

### Tornadoes, Hurricanes, and Other High Wind Events

Tornadoes are a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground and is most often generated by a thunderstorm. Circulating winds greater than 40 mph are defined as tornadoes, and the most violent tornadoes have rotating winds of 250 miles or more. In the past 60 years, 12 unique tornado events have been identified and confirmed in Lancaster County, representing an estimated annual future occurrence of 20 percent (Lancaster County 2012).

Tropical cyclones (e.g., tropical depressions, tropical storms, and hurricanes) develop over large, warm waterbodies such as the ocean, can be hundreds of miles across, and are usually comprised of large amounts of moisture. A tropical depression has maximum sustained winds of less than 39 mph, a tropical storm has winds up to 74 mph, and a hurricane has maximum sustained winds over 74 mph. Extending back to 1854, tropical cyclones occurred in Lancaster County 36 times, with 10 storm centers passing over the county (Lancaster County 2012). The probability of future tropical storm events was estimated to be 18 percent annually (Lancaster County 2012).

### Excessive Precipitation

A *heavy* or *excessive precipitation event* is classified as an event in which rain, sleet, snow, hail, or freezing rain is falling at a rate of 0.30 inch or greater per hour, or greater than 2 inches in a 24-hour period (Lancaster County 2012). Severe thunderstorms have wind speeds greater than 58 mph, produce hail at least 0.75 inch in diameter, or produce tornadoes. The average storm is 15 miles in diameter and lasts an average of 30 minutes. During the last 60 years, 114 severe thunderstorms (without tornadoes) have been documented in the county (Lancaster County 2012).

Flooding may occur with any severe thunderstorm or tropical storm. Hurricanes are considered the most significant reasonable and foreseeable heavy rain event. Flood conditions may result from heavy or excessive rainfall over an extended period of time and may produce a flash flooding hazard, which could endanger life and cause damage to mining equipment and mine facilities. According to information gathered from the National Climate Data Center, there is a 75-percent chance of a flood occurring annually in Lancaster County, which yields a 0.21-percent chance of occurrence per day. Although the National Climate Data Center has recorded only 12 flood events for Lancaster County from 1994 through 2012, historical flood events dating back to 1859 have been recorded through other documentation (Lancaster County 2012).

### Freezing Conditions

The average temperature for the Project area ranges between 50 °F in winter to 80 °F in summer. The coldest month is January, with an average temperature of 43 °F (AMEC 2012). However, freezing conditions in the Project area are possible during winter. Prolonged periods of sub-freezing temperatures may adversely affect mine worker safety from frostbite and mining equipment, piping, storage structures, and water routing through the plant site and ore processing facility. Available data for winter storms, including snow, ice, or mixed precipitation events, were recorded in Lancaster County for the last 52 years. During that period, 37 individual events were noted, with average accumulations from 1.53 inches for ice events and 2.26 inches for snow events. The hazard mitigation plan estimates the probability of future occurrence at 71 percent for an annual winter storm, with damages expected to be low to medium (Lancaster County 2012).

### Wildland Fires

A *wildland fire* is an uncontrolled fire that is unplanned that may occur from human activity or natural combustion, such as excessive heat or lightning strike (NWCG 2012). Wildland fires are possible in the Project area and are considered common occurrences (76-percent chance per day) by Lancaster County Fire Service (Lancaster County 2012). Wildland fires harm humans and cause damage to mining equipment and mine facilities. The Lancaster County Fire Service has responded on average to more than 275 wildland fires per year over the past 5 years. Due to the common occurrence of wildland fires, the Lancaster County Fire Service and other volunteer firefighting forces, such as Kershaw, Flat Creek, and Rich Hill Fire Departments, are adept at handling most fires without assistance. In the event that a fire extends beyond the capabilities of local resources, the South Carolina Forestry Commission (SCFC) must be called for assistance (Lancaster County 2012).

The SCFC has recorded historical occurrences of fire incidents by county. Based on a 62-year long data set, the SCFC responded to fires in Lancaster County at a rate of approximately 50 times per year, which yields a 23-percent chance of occurrence per day. The 10-year average indicated 34 responses per year, with an average of approximately 133 acres involved per year, while the most recent 5-year average indicated an estimated 32 fires per year, with an average of approximately 120 acres involved per year (SCFC 2011; Lancaster County 2012).

### 3.18.2.3 Emergency Response

Public emergency service agencies and departments are available to respond to fire and special operations, emergency medical response, and police needs for the Town of Kershaw and Lancaster County. Each of the responsible agencies and departments has indicated that sufficient support services are available to respond to incidents at the Project site, as described below.

Flat Creek Volunteer Fire Department would be the first department to respond to fire and emergency medical calls at the Project site, with a response time from the Flat Creek Fire Department of approximately 5 minutes. For structural fire calls, Flat Creek, Kershaw, and Rich Hill Fire Departments would be called to the site, with a pumper truck and tanker truck from each station.

For all medical calls, certified first responders also would respond as needed, with Lancaster County Emergency Medical Services (EMS) as the automatically assigned responders. Lancaster County EMS has three ambulances and one Quick Response Vehicle located within a 16-minute response time to the Project site.

Special operations also are supported for rope rescue, search and rescue, and confined space and hazardous materials incidents; initial responses are handled by County Fire Departments (Kershaw, Flat Creek, and Heath Springs). The Flat Creek Fire Department has two hazardous material technicians that could support a hazardous materials response team from Lancaster County EMS, as needed (Flat Creek Volunteer Department 2012). Hazardous materials incidents are handled jointly by the City of Lancaster Fire Department and the Lancaster County Hazardous Materials Team once the primary response agency determines the response needs for such incidents (Kershaw Fire Department 2012). Large or prolonged incidents are handled by Lancaster City Fire Department and the STAR (Specialized Training And Response) Team, with a response time of 20 to 30 minutes (Lancaster County EMS 2012).

Lancaster County Sheriff’s office provides 24-hour coverage for the Project area. Response capabilities range from routine patrol responses to full turnout by the County Sheriff’s Office Metro Special Weapons and Tactics (SWAT) Team. Response times are estimated to be 5 to 10 minutes for emergency situations, and the SWAT Team can have a full response to the site within a 30- to 45-minute period, if needed (Lancaster County Sheriff's Office 2012).

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# 3.19 Hazardous Materials and Waste

*Hazardous waste* and *hazardous materials* are defined as substances or industrial byproducts that are destructive to the environment, harmful to humans or animals, and require specialized handling. Issues related to hazardous materials and waste include potential human health risks from the use and handling of hazardous materials; accidental release of hazardous materials to the environment from storage within the Project boundary; accidental release of hazardous materials to the environment from transport within the Project boundary; and potential impacts from disposal of hazardous waste outside the Project boundary. The study area for hazardous materials and waste is the area inside the Project boundary.

## 3.19.1 Regulatory Setting

The following key federal and state regulations governing hazardous materials are applicable to the Project. See Appendix F for additional regulations that apply to the Project.

- **Hazardous Materials Transportation Act –** The primary objective of the Hazardous Materials Transportation Act (49 USC 5101–5127) was to provide adequate protection against the risks to life and property inherent in the transportation of hazardous material in commerce by improving the regulatory and enforcement authority of the Secretary of Transportation. A *hazardous material*, as defined by the Secretary of Transportation, is any "particular quantity or form" of a material that "may pose an unreasonable risk to health and safety or property."
- **Mine Safety and Health Act of 1977** – The MSHA is a government agency whose goals are to prevent death, disease, and injury from mining and to promote a safe and healthful workplace for the nation's miners. The MSHA administers the provisions of the Mine Act, enforcing compliance with mandatory safety and health standards to eliminate fatal accidents, reduce the frequency and severity of nonfatal accidents, minimize health hazards, and promote improved safety and health conditions in U.S. mines. The Mine Act is carried out at all mining and mineral processing operations in the United States.
- **Pipeline and Hazardous Materials Safety Administration Title 49 CFR** – The Pipeline and Hazardous Materials Safety Administration (PHMSA) is a USDOT agency that develops and enforces regulations for the safe, reliable, and environmentally sound operation of pipeline transportation and shipments of hazardous materials by land, sea, and air. PHMSA Title 49 requires operators to conduct drug and alcohol testing of covered employees who perform operations, maintenance, or emergency response functions. Title 49 also prescribes safety standards and reporting requirements used in the transportation of hazardous materials.
- **Oil Pollution Prevention –** The Oil Pollution Prevention regulation (40 CFR 112) sets forth requirements for prevention of, preparedness for, and response to oil discharges. To prevent oil from reaching navigable waters and adjoining shorelines, and to contain discharges of oil, the regulation requires applicable facilities to develop and implement SPCC Plans and establishes procedures, methods, and equipment requirements (Subparts A, B, and C).
- **Standards Applicable to Generators of Hazardous Waste** – The Standards Applicable to Generators of Hazardous Waste (40 CFR 262) are a set of regulations for facilities that generate hazardous waste. Facilities that treat, store, or dispose of hazardous waste onsite must only comply with guidelines and regulations outlined by the USEPA, including obtaining a USEPA identification number for treatment, storage, disposal, and transport of hazardous waste; calculate the accumulation of hazardous waste; maintain proper recordkeeping; and complete additional reporting, if necessary (Subparts A, B, C, and D). Title 40 CFR 262.34 (d)(5)(iii) sets forth requirements for Hazardous Waste Handling and Emergency Procedures Training.

- **Standards for Universal Waste Management Title 40 CFR 273 –** Part 273.16 concerns Universal Waste Small Quantity Handlers Training.
- **Resource Conservation and Recovery Act of 1976 –** The Resource Conservation and Recovery Act (RCRA) addresses non-hazardous and hazardous waste management activities and governs the disposal of solid and hazardous waste. RCRA bans all open dumping of waste and mandates strict controls over the treatment, storage, and disposal of hazardous waste. RCRA gives the USEPA the authority to control hazardous waste, including its generation, transportation, treatment, storage, and disposal. The 1986 amendments to RCRA enabled the USEPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances.
- **South Carolina Mining Act of 1974** – The SCMA was passed in 1974 for the protection of people and the environment to ensure all mined lands would be returned to some useful purpose. The Act and regulations outline the minimum reclamation standards as well as how to conduct mining operations.
- **South Carolina Mining Regulation 89-330** – Regulation 89-330 establishes post mine land use criteria and minimum standards for reclaiming mine lands. This regulation includes minimum standards required for specific types of land use, specific excavation safety requirements, and design standards for various features.
- **South Carolina Mining Regulation 89-220** – Regulation 89-220 requires any request for a modification of a mining permit and/or reclamation plan to be completed on Form MR-1300, Application for Modifying a Mining Permit and/or Reclamation Plan, and submitted to the Mining Council of South Carolina.

## 3.19.2 Existing Conditions

This section describes the past mining activities on the Project site, the types of hazardous materials and waste that would be used for the proposed Project.

### 3.19.2.1 Past Mining Activities

The Project site has undergone intermittent past mining activities beginning in the 1830s and ending in 1992. Gold and pyrite were mined by both open-pit and underground mining techniques. Gold was extracted by the Theis barrel chlorination process, which uses bleach powder (2CaOCl) and sulfuric acid ($H_2SO_4$) to remove the gold from pyrite, and by heap leach and residual gold recovery, which primarily use an alkaline cyanide solution to extract the gold from the rock (Haile 2006; International Textbook Company 1902; Trexler et al. 1990). Mining activities at the Project site from the 1830s to 1942 did not have a regulatory framework addressing mine reclamation or assessment of hazardous materials. In 1974, the SCMA was passed, and before mining resumed in 1984, Piedmont Mining Company, Inc. was issued South Carolina Mining Permit #601 pursuant to the regulations under the SCMA. This permit was modified for each new pit or facility area. Each modification included an area-specific reclamation plan to comply with South Carolina Mining Regulation 89-220 (Haile 2012). In addition, since its passage in 1976, RCRA governed the handling of solid and hazardous waste on the Project site.

In 1994, 2 years after mining ceased at the Project site, the site was placed on the State's list of impaired waters (Section 303[d] list) based on pH and toxics sampling results from monitoring station PD-334. Reclamation work on the Project site began in 1994 under the authority of Mining Permit #601 and the requirements of state law and regulation. Reclamation efforts have included lime-amending sulfide-bearing rock and materials to neutralize the acidity of the rock and soils to prevent acid mine drainage, installing HDPE liners and substantial inert soil cover to minimize precipitation contact with potentially acid generating materials, and revegetating facilities to provide native undergrowth.

Each former mining facility (either permitted under Mining Permit #601 or historically existing before the SCMA and RCRA) has been reclaimed or closed according to Regulation 89-330 *Criteria for Approval of Reclamation Plan and Completed Land Reclamation*. In 2004, the Project site facilities were no longer on the State's list of impaired waters, and all reclamation efforts for historical facilities were completed by 2005. Each former mining facility's reclamation plan was submitted individually to the State for review and approval. Other reports and filings, as required by the State, provide information about these activities. For a detailed summary of the reclamation efforts for each facility, refer to the Haile Mine Reclamation Summary (Haile 2006).

### 3.19.2.2 Types of Hazardous Materials and Waste

Hazardous materials and waste would include mine processing fluids and reagents (e.g., cyanides, laboratory reagents, fueling materials, and related lubricants and solvents) and general administrative materials that would be used in various operations (e.g., fueling vehicles and ore processing). Brief descriptions of the major categories of hazardous materials are provided below, based on *Supplemental Analysis to the Mill Process Description* (M3 Engineering & Technology Corporation 2012) and *Fundamentals of the Analysis of Gold, Silver, and Platinum Group Metals* (Anderson no date). Further descriptions of hazardous materials that may be used as part of the Project are provided in the Applicant's Solid and Hazardous Waste Management Plan (Haile 2011). PAG material is exempt from inclusion as a hazardous waste under RCRA[1] and therefore is not discussed in this section (USEPA 2012).

#### *Mine Processing Fluids and Reagents*

Ore processing would require significant quantities of reagents to perform the chemical processes proposed to extract the gold at the plant site. Reagents that would be used in the handling, mixing, and distribution systems include the following:

- Sodium cyanide (NaCN). Sodium cyanide solutions would be prepared by adding water to a sodium cyanide mix tank and circulating the solution between the mix tank and bulk delivery truck until all of the dry cyanide has been dissolved. The sodium cyanide solution would be distributed to the carbon-in-leach (CIL) circuit and barren strip solution tank using individual metering pumps.
- Quicklime (pebble lime) (CaO). A milk of lime slurry would be distributed to the CIL circuit, cyanide detoxification tanks, and thickeners using timer-controlled valves in a circulating loop. Dry pebble quicklime would be delivered in bulk quantity and pneumatically off-loaded to a cone-bottom lime silo storage bin.
- Aero 404 and potassium amyl xanthate (PAX). Aero 404 and PAX would be added to the SAG mill prior to flash flotation and to the rougher flotation conditioning tank. These reagents would be delivered using individual metering pumps.
- Caustic (sodium hydroxide) (NaOH). Caustic soda solution would be used in the carbon strip circuit to neutralize acidic solutions after acid washing the carbon and as a reagent in the carbon stripping process. It also may be added to the cyanide mixing system as needed to maintain pH. This solution would be delivered using individual delivery pumps.

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[1] In October, 1980, RCRA was amended by adding Section 3001(b)(3)(A)(ii), known as the Bevill exclusion, to exclude "solid waste from the extraction, beneficiation, and processing of ores and minerals" from regulation as hazardous waste under Subtitle C of RCRA.

- Ammonium bisulfite (ABS). ABS would be used in the tailing detoxification circuit as the primary source of sulfur dioxide to oxidize free cyanide and weak acid dissociable metal cyanides. The ABS solution would be pumped directly from the storage tank to the cyanide detoxification tanks using a metering pump.
- Copper sulfate ($CuSO_4$). Copper sulfate would be added to the cyanide detoxification tanks to provide copper ions as a catalyst for the copper detoxification process. It would be delivered in supersacs and stored in a dry area, with an agitated mixing tank and a holding tank as part of the system.
- Hydrochloric acid (HCl). Hydrochloric acid would be used in the carbon strip circuit to acid wash carbon. It would be delivered in bulk quantity and off-loaded from the bulk truck to a storage tank. Dilute acid solutions would be prepared by pumping acid directly from the storage tank to the acid wash circulating tank, as needed.
- Sulfuric acid ($H_2SO_4$). Sulfuric acid would be used in the grinding and rougher flotation circuits to maintain pH. It would be delivered in bulk quantity and off-loaded to a storage tank. Metering pumps would be used to deliver the acid to the SAG mill and to the rougher flotation conditioning tank.
- Lead nitrate ($PbNO_3$). Lead nitrate would be added to the pre-aeration tank to enhance leaching. Dry lead nitrate would be delivered in 25-kilogram pails and stored in a dry area. A metering pump would be used to deliver lead nitrate solution to the pre-aeration tank feed box.
- Flocculant. Flocculant would be added to the pre-aeration thickener, to the flotation tailing thickener, and to the cyanide recovery thickener to enhance solids settling. It would be delivered in supersacs and stored under cover at the reagent facility located onsite (Figure 4.19-1 in Section 4.19).
- Antiscalant. Antiscalant would be added to the reclaim water and internal reclaim water tanks to prevent scaling in pipelines and tanks. It would be delivered in bulk quantity and would be added to the process using metering pumps directly coupled to vendor-supplied tanks.
- UNR 811A. This chemical may be used in the ore processing facilities, if needed, to reduce mercury production. If used, it would be added to the reclaim water tank and internal reclaim water tank using metering pumps directly coupled to vendor-supplied tanks.

### *Laboratory Reagents*

Fire assaying in the laboratory separates gold from heavy metals in the ore to determine grading. The exact reagents are determined by geochemical testing of the ore rock. Because these compounds are used in the laboratory, they are stored in much smaller quantities than those for the gold removal process from ore rock. In general, reagents used in the fire assay process include:

- Flux. Flux are added to the pulverized ore in a fireclay crucible to cause a fusion at an easily attained temperature. The exact flux components depend on the geochemistry of the ore. Sodium carbonate, litharge, silica, borax, calcium fluoride, flour, and potassium nitrate are common flux agents used in fire assaying. (See descriptions below.)
- Sodium carbonate ($Na_2CO_3$). Sodium carbonate may be considered a desulfurizing and oxidizing agent.
- Litharge (PbO). Litharge is a basic flux and acts as a desulfurizing and oxidizing agent.
- Silica ($SiO_2$). Silica is a strong acidic reagent that combines with the metal oxides to form silicates to protect the crucible from corrosive action of the litharge.
- Borax glass ($Na_2B_4O_7$). Borax glass becomes a fluid and strong acid when heated, and will dissolve and flux practically all metallic oxides, both acidic and basic. Borax glass also facilitates slagging of

ore and lowers the fusing point of all slags. *Slag* is defined as the stony waste matter separated from metals during the smelting or refining of ore; *slagging* is the production of slag.

- Calcium fluoride ($CaF_2$). Calcium fluoride increases the fluidity of almost any charge and is used when the aluminum content of the sample is 1 percent or more.
- Potassium nitrate ($KNO_3$). Potassium nitrate, or niter, is a strong oxidizing agent used to chiefly oxidize sulfide-bearing ores.
- Nitric acid ($HNO_3$). Nitric acid dissolves the silver and leaves the gold. Separation of the gold and silver occurs in a process called *parting*, which requires one part of nitric acid in seven parts of distilled water.

#### *Fueling Materials and Related Lubricants and Solvents*

Bulk quantities of gasoline and diesel fuel would be required to support mining equipment operations. Various lubricants and solvents, such as engine coolant/anti-freeze, engine oils, gear oil, and hydraulic fluid, would be used to maintain mining equipment.

#### *General Administrative Materials*

Various wastes would be generated in working locations at the Project site, including the administration buildings, other mining and mineral processing departments and buildings, and the truck shop and warehouse area. General administrative materials include office and lunchroom wastes, janitorial products, lamp bulbs, paints, cleaners, lubricants, batteries, sanitary wastewater, and biohazard waste.

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